Railway Mechanical Engineer

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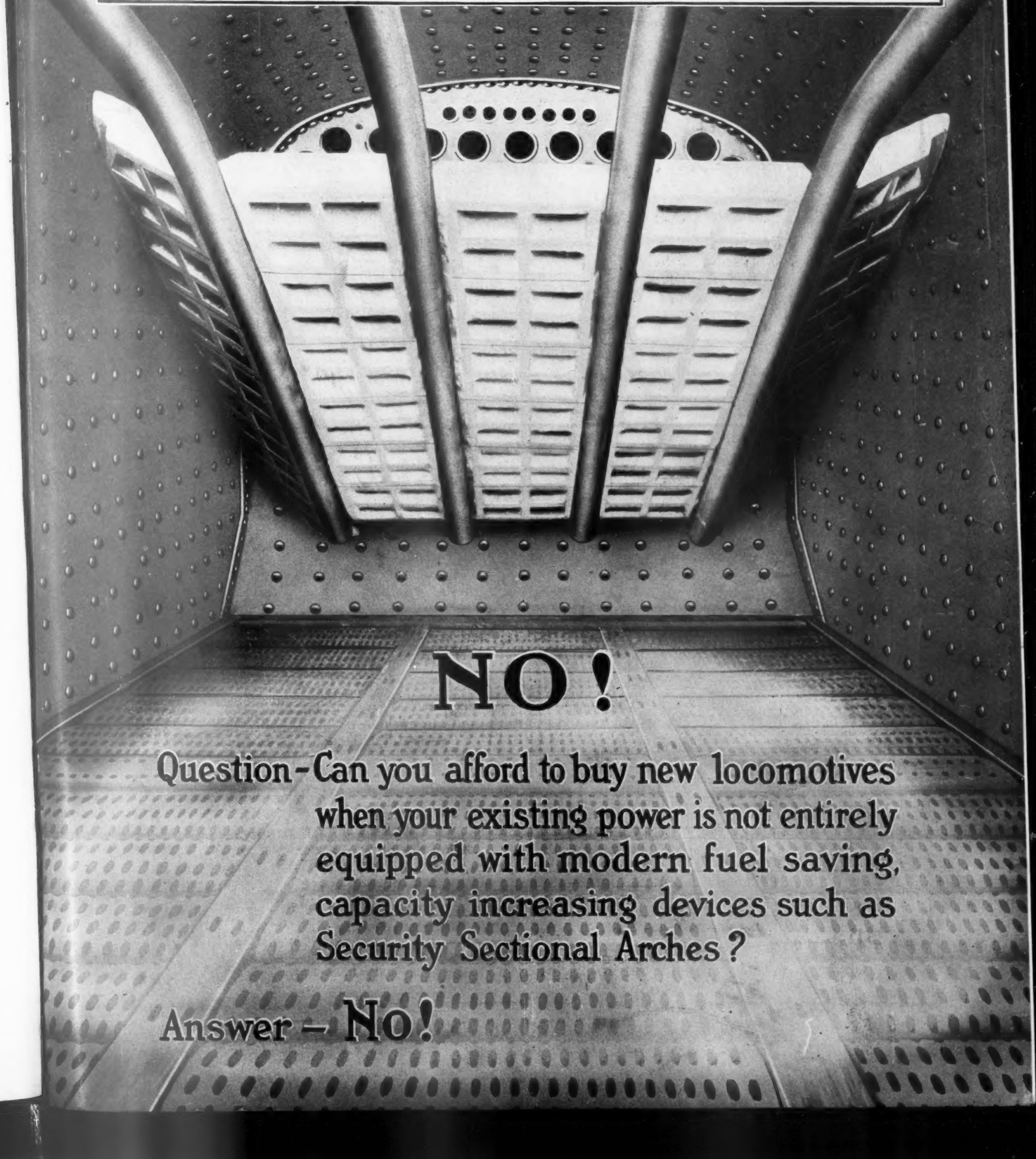

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Volume 91 February, 1917 No. 2

We Want to Know

We wish to secure several good articles covering different phases of milling machine practice in railroad shops. For instance, one reader might be able to supply information of special value as to the use of a certain type of milling machine for work which had previously been done on another type of machine at a greater cost or with less satisfactory results. Another contributor might be able to discuss the care and handling of milling machines in order to get the best work from them. Still another might have special information as to the design of the various types of cutters, or possibly of only one type. Still another may have devised jigs or special methods for performing a certain class of work and thereby greatly increasing the output of the machine. These are only a few suggestions. There are a great variety of different problems concerning the advantages and use of milling machines in railroad shop practice, of detail methods of handling the work, and of the design, manufacture and maintenance of the tools, cutters and jigs used in connection with them. In order that we may present a complete study in the form of special contributions to our readers, we shall offer three prizes of $20 each for the best articles from the practical viewpoint which are received at our office in the Woolworth Building, New York, not later than April 1, 1917.

Valuation in the Mechanical Department

There are a variety of opinions as to how thoroughly the valuation of the railways should be conducted. Some mechanical officers take this matter seriously, while others do not. There is one thing certain, however, and that is unless the mechanical department has sufficiently accurate information and data to support its valuation figures there will be an extended controversy between the road and the federal authorities. No rule of thumb method should be followed. Only absolute cold and definite facts will stand the test of scientific analysis. The work is being done at a great cost, and but little additional cost will be required to get the information completely and scientifically. Those roads that do not do this are taking a chance. It may result in the acceptation by the government, of an unfairly low valuation, or in the necessity of going over the work again more thoroughly.

From the statement of the law it is apparent that the federal government is after definite information as to the absolute cost and value of the entire railway property. Undoubtedly, in many cases a road's valuation will in the end have to be handled by the railway lawyers. Lawyers are not mechanical men. They will be unable properly to argue their cases without definite and concrete information, nor will they be able to make their arguments good unless they can show how the information was obtained. Every bit of calculation with thorough explanation of the methods followed, should accompany each item valuated. The computation should be based on fair and unquestioned premises. Absolute concrete data is what is needed, and it will be found in the end to be worth considerably more than rule-of-thumb estimating by competent men, however expert they may be.

Analyze Your Engine Failures

The successful man is known to be the one who seldom makes the same mistake twice. This applies equally as well to the successful mechanical department. Needless to say, if it were possible to prevent engine failures recurring from the same causes the locomotives of this country would be in a very high state of efficiency. Regardless of how impossible this may seem, there is much to be done in the reduction of engine failures. If every failure were carefully analyzed and the basic cause of the failure determined, a great deal could be done to eliminate them. One road states that the average cost per engine failure, exclusive of labor and material for repairs, amounts to $17. Cases have been known where this cost amounted to over $250, and it was a small failure at that. Adding the cost of labor and material for repairs, the cost per engine failure would be far in excess of the above mentioned average.

The cost is not the only consideration. The reputation of the mechanical department is based very largely on the service it renders. The effect of engine failures is felt throughout the entire operating department, and every means should be taken to reduce them to a minimum. One mechanical department officer has taken special pains to impress upon his men the importance of finding the underlying causes for the engine failures as they occur. Where it is found that they are caused by some inherent defects in the locomotive, strong efforts are made to correct them and the necessary changes are made at the first opportunity. Some roads make as many as 40,000 and 50,000 miles per engine failure, while others average below 10,000 miles. There are, therefore, large opportunities for improvement. It can be done, and it is important that it should be done. Good results can be accomplished only by a very careful analysis of every failure as it occurs, and by making corrections in the design and construction of the equipment to obviate them.

Freight Car Repair Track Earnings

Most railway men do not fully appreciate the opportunity there is for obtaining actual profit from the car repair tracks. An investigation made by a road in the middle West has shown that under normal conditions a net profit of about $1 per car per day can be made under the M. C. B. prices. This road has taken special efforts to impress this fact upon the repair track foremen. Such profits, however, cannot be realized at the present time on account of the high cost of labor and material, although the 25 per cent increase to the face value of

all car repair bills recently authorized by the executive committee of the Master Car Builders' Association will tend to make some of these tracks profitable. Careful attention should be given to the arrangement of the cars on the track. Cars with light repairs should not be switched in between cars requiring heavy repairs, as time will be lost in getting the car back into service and it will occupy valuable space on the repair track. A few extra minutes used in properly switching the bad orders and classifying them according to the extent of the repairs to be made will be found to be well worth while.

The car repair forces should be well organized and provided with facilities for expediting the work. The repair track should be located convenient to the storehouse and the shops so that as little time as possible will be taken to provide the proper material for the repairs. The yard should have outlets on either end, and where it is composed of more than one track the bad order cars should be classified according to the time it will take to make the repairs. Where it is found necessary to hold a car for shipment of material from owning roads, it will also be found profitable in many cases to remove the car from the repair track, thus allowing another bad order car to take its place. If every car foreman in charge of repair tracks will analyze his particular plant, he will be surprised to see the profit that may be obtained in this work, considering, of course, the service value of the car.

The Cost of Equipment Failures

We all know what trouble is caused the mechanical department by equipment failures, but do we fully appreciate what it costs the railroads in actual money? Of course it is difficult to determine just what the amount is but the following incident will indicate to some extent what it may be. A through passenger train which was running on a fast schedule was stopped 31 miles from a terminal by an engine failure due to defective reversing gear. The accident was such that the engine could only run in full gear forward. Engines were exchanged with a fast freight train that happened to be in the vicinity and the passenger train proceeded. About five miles from the engine terminal the air supply gave out as the freight engine did not have sufficient compressor capacity. The brakes were bled and the train was taken in under the hand brakes, much to the discomfort of the passengers. A passenger engine was put on at this point and the train proceeded, only to be delayed at the next station by a defective baggage car which had to be replaced and the baggage transferred. This made the total delay to the train about one and one-half hours.

In addition to its through business this train handles a large passenger and mail business from a point about 300 miles from its destination and which is in competitive territory. To save this business and also to relieve the through train from many intermediate stops a special section of six cars was made up at this point and sent out a little late. The total delay of the through train at its final destination was only 15 minutes, and the special section came in a little later. Thus the through passengers and the local passengers from the city above referred to were but little inconvenienced.

This, however, was accomplished at a considerable expense to the railroad. The cost of the special section was in itself a fairly large item, but in addition to this there was the delay to the fast freight train, the delay to the intermediate passengers on the through train, the cost of a baggage car transfer, the extra fuel consumption caused by an additional locomotive and extra fast runs to make up lost time, and wages for overtime to some of the train crews affected.

This was the cost of two equipment failures on the same train. Others may be more or less expensive while some may even mean loss of life. Is it not well worth while, therefore, to provide a sufficiently large force to properly inspect each piece of equipment?

Locomotive Tractive Effort Formulas

In this issue will be found a discussion of the Kiesel locomotive tractive effort formula by Lawford H. Fry, which is of interest as furnishing a ready method of calculating the tractive effort for any speed from the principal dimensions of the locomotive. Mr. Fry has departed somewhat from the usual practice and his method should provoke lively discussion on this subject, which is always of interest to designers.

The empirical formula upon which Mr. Fry's method is based was developed from the results of tests of locomotives using saturated steam and its application to engines using superheated steam is open to criticism. There is an inconsistency in basing the value of K on the total heating surface, including the superheater, as there is of course no actual evaporation in the superheater and the effect of the increase in the volume of the steam can be taken care of in the formula. The value of the hourly evaporation per square foot of heating surface K for superheater engines is apparently an arbitrary figure. Using the total heating surface of the superheater engine and changing the value of K compensates for the effect of the elimination of initial condensation and the difference in the rate of heat absorption in the boiler and superheater, which Mr. Fry has assumed to be the same, but the method is hardly logical.

The former practice of calculating tractive effort by applying a speed factor to the rated tractive effort is no longer used when trustworthy data is desired and while Mr. Fry goes a step farther in taking account of some of the numerous factors on which the tractive effort depends, it would seem better in making such calculations to estimate the total evaporation by making use of the data now available concerning the rate of heat absorption in various parts of the boiler, modified to suit the particular case under consideration. The numerous tests which have been conducted on modern locomotives make it possible to estimate the water rate with a fair degree of accuracy and by applying the water rate to the total evaporation, and determining the horse power, the tractive effort can be calculated.

This method is not as easily applied as the formula given by Mr. Fry and the choice between the two systems is a matter in which each designer will use his own judgment. It would be interesting to know the consensus of opinion on this subject and contributions from our readers will be welcomed.

A Neglected Function of the Testing Department

The testing department of a railroad has two principal functions, both of vital importance in promoting efficiency. The first of these, the testing of materials, is so evidently important that a staff of specialists is usually engaged to attend to it and the organization is built up on a permanent basis. The investigation of new methods and the testing of new devices, while no less important, is not so much a matter of routine and unfortunately the work along that line is regulated largely by the financial showing of the railroad. An organization built up with care is often destroyed when drastic retrenchment is demanded. It is for this reason, probably, that so few railroads have adequate facilities and a trained force for testing new devices.

That the matter is of sufficient importance to warrant attention, no one will deny. The amounts which the railroads spend for fuel, oil and supplies make the saving of even a small percentage of the total a matter of great importance. A comparatively slight percentage of saving in operation

justifies an expenditure of large amounts of money and yet, in spite of the enormous sums which the railroads are spending for improvements, their purchases are seldom based on specific knowledge of the performance which can reasonably be expected of the devices purchased. There are certain devices whose efficiency has been demonstrated until it is no longer questioned, but there are many more of questionable merit which are adopted because the arguments advanced in their favor are plausible and no one is in a position to say that they will not do what is claimed for them. An efficient testing department should determine the value of new devices so that they can be adopted at once if they will effect a saving, or definitely rejected if found worthless.

The lack of energy in developing the superheater, even after the economy of superheated steam had been demonstrated, is an instance of the indifference toward new devices manifested by American railroads. The Clench superheater was patented in 1896, the Cole superheater in 1904, and the Schmidt superheater was developed in practically its present form in 1906. At the St. Louis tests in 1904 an engine equipped with a Pielock superheater showed a steam consumption of 16.6 lb. per indicated horsepower hour, while the lowest steam consumption for an engine using saturated steam was 19.4 lb. per indicated horsepower hour. In spite of this demonstration of the marked economy of superheated steam and the feasibility of using a high degree of superheat, there was only one railroad on this continent which took a prominent part in the development of the superheater, and the device was not generally applied in considerable numbers until about 1912.

In purchasing valve gears, how many roads will consider the first cost and the cost of repairs and neglect the more important question of relative coal consumption? So far as we know, no railroad in this country has tested the valve gears now on the market with a view to determining their relative economy, taking all factors into consideration. Certainly the importance of the question would warrant a careful investigation, and this is but one of many problems which should be handled in a broad, thorough way. Each great railroad system should have an organization capable of taking care of all such matters. For the smaller roads it is not feasible and here is the field for a joint experiment station.

The particular form of testing department organization which will give the best results is a matter which each railroad will determine for itself. At present the important thing is to organize the work so that the standards can be established, not on a vague general idea of relative merits, but on a sound basis of the amount which can be saved in dollars and cents.

Car Inspectors Need Better Training

The *Railway Mechanical Engineer* has gone on record many times in recent years concerning the necessity of giving more real attention to the selection and training of car inspectors. Hiram W. Belnap, chief of the Division of Safety of the Interstate Commerce Commission, in a paper before the Central Railway Club, which is abstracted elsewhere in this issue, made a most forceful and able presentation of this subject. While he did not attempt to tell in detail how the situation could be improved, he clearly pointed out facts and made a number of suggestions which, if adopted, would do much to improve conditions. In addition to the car inspector's duties, as outlined in the paper, several more might be added, including a working knowledge of local agreements and the peculiar requirements which exist at many interchange points. What other class of railway employees must fulfill such exacting requirements, or have it within their power to save or waste more money, or to protect or endanger so many lives? Is it not to be wondered at that so little systematic attention has been given to the selecting and training of these men?

Inasmuch as the greater number of the car inspectors are promoted from freight car repairmen, it would seem that the place to begin is in giving more care to selecting men when they first enter the service and in seeing that they are thoroughly instructed in their duties, as well as in those things which may fit them for promotion to more important positions. With a few notable exceptions, the railroads generally have entirely disregarded the necessity of so doing. Indeed, officers at the heads of the car department who have had many years of practical experience, while admitting the seriousness of the conditions, will insist that a satisfactory apprentice system, similar to that used in the locomotive department, cannot be installed. They will claim that even in the smaller towns it is useless to try to attract the higher grade of boys, because the work of the freight car repairman is classed almost with that of the common laborer. Then, too, it will be argued that these men need to know how to do well only a few jobs or operations and do not need a general training in the work. Difficulty has also been found in keeping the boys to the end of their apprenticeship because of more attractive positions in other fields.

Is there not something wrong with a system which allows such conditions to exist? Industrial managers are beginning to realize that one of the great extravagances of the American industrial system is the continual hiring and firing of men. Steps are being taken by many concerns to remedy this condition. Is it not time that the railways also awakened to their responsibilities in the matter?

The real executive not only has vision and foresight, but has the ability to impress those above him and make them see in concrete terms the possibilities which lie ahead. Those in charge of the car department cannot very well afford to "pass the buck" and claim that there is inadequate supervision or that the higher officers are not sympathetic. It is their business to impress these higher officers with the necessities of the case and to give adequate attention to the great problems affecting the human element.

Several suggestions were made at the Central Railway Club meeting which will be helpful in the solution of the problem. In order to attract the right kind of men to the car repair department and develop efficient and effective car inspectors it may be necessary to increase the wages, but there are other things of at least as great importance. For instance, they must be made to feel that they are a vital part of the organization. Their positions must be dignified and facilities should be provided which will make their work as convenient and comfortable as possible. Above all they must be given systematic and thorough instruction in their duties and with a view for fitting them for promotion. Truly, it is a big problem, requiring the services of big men, and on its solution depends to a great extent the future welfare of our railways.

NEW BOOKS

Proceedings of the Master Car and Locomotive Painters' Association. 116 pages, 6 in. by 9 in. Published by the association. Albert P. Dane, secretary, Reading, Mass.

This is the report of the forty-seventh annual convention of the Master Car and Locomotive Painters' Association which was held September 12, of this year, at Atlantic City. It contains a report of the test committee, which during the year made a number of tests on heat treated linseed oil and on various paint materials, to find which will offer the greatest resistance to sulphuric acid. Other reports and papers are included in the book concerning the painting of steel passenger car equipment, the treatment of light colored headlinings, proper method of classifying cars for the shop, economy in railroad paint specifications, removing varnish and cleaning cars.

Virginian Triplex Locomotive

Total Weight 844,000 Lb.; Maximum Tractive Effort 166,000 Lb.; Designed for Heavy Pusher Service

A TRIPLE articulated compound locomotive, with 2-8-8-4 wheel arrangement, has recently been built by the Baldwin Locomotive Works for the Virginian Railway. As far as the general principles of its design are concerned, this locomotive is similar to the Erie Triple locomotives, which have now been in service a sufficient length of time to demonstrate the value of the type in heavy grade work. The Virginian locomotive exerts a maximum tractive effort of 166,300 lb. and was designed with a height limit of 16 ft. 10 in., and a width limit of 12 ft. at a height of 2 ft. 3 in. above the rail. The center line of the boiler is placed 10 ft. 9 in. above the rail. Flanged tires are used throughout the lateral play between rails and flanges, being ⅞ in. on the front and back drivers of each group, and ⅝ in. on the main and intermediate pairs. The locomotive is turned on Y's, on which the curvature is 18 deg.

The boiler is of the wagon top type, with an outside diameter of 100 in. at the third ring. Both the main and auxiliary domes are mounted on this ring, the latter being placed over at 15-in. opening in the shell. The longitudinal seams are all placed on the top center line. That on the dome ring is welded throughout its entire length, while the seams on the first and second rings are welded at the ends. The circumferential seam uniting the second and third rings and the seam uniting the third ring with the throat and outside firebox sheets are triple riveted. The back tube sheet is straight, and the tubes have a length of 25 ft.

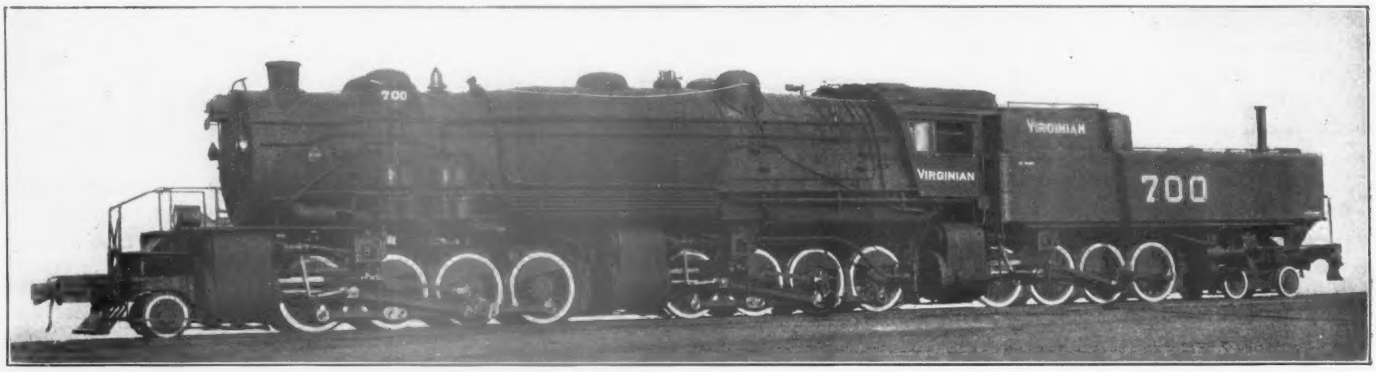
The furnace is of the Gaines type, fired by a Street stoker, and the arch is supported on five tubes. As the firebox is placed above the middle group of driving wheels, the space available for the throat is exceedingly restricted, and sufficient depth of throat has been obtained by depressing the front bar of the mud ring between the wheels. Flexible bolts stay the throat and back of the firebox and are used in the breakage zones in the sides, while four rows of Baldwin expansion stays support the forward end of the crown. The mud ring is supported on vertical plates at the front and back, and at one intermediate point. Here the load is transferred to the plate through a transverse, cast steel brace, which is strongly ribbed, and supports the longitudinal grate bearers. The ash pan, in spite of the limited space available, has two large hoppers with cast steel bottoms and drop doors. The back receiver pipe and reach rod pass through the pan, a longitudinal duct being provided for this purpose. Provision is made for admitting air at the front of each hopper and near the top of the duct at each side, as well as under the mud ring.

The throttle is of the Rushton type, designed to suit the restricted clearance limits. The dome is 10 in. high and 36 in. in diameter; the opening in the shell measures 20 in. longitudinally by 28 in. transversely. The throttle valve is seated immediately over this opening, and on the throttle pipe is cast a supporting bracket which is bolted to the boiler shell. The valve is lifted by a transverse rotating rod, which passes through a stuffing box in the side of the boiler below the dome and has an outside connection with the throttle lever. The latter is placed in a vertical position, and is designed to give maximum leverage and slowest travel of the valve at the beginning of its movement.

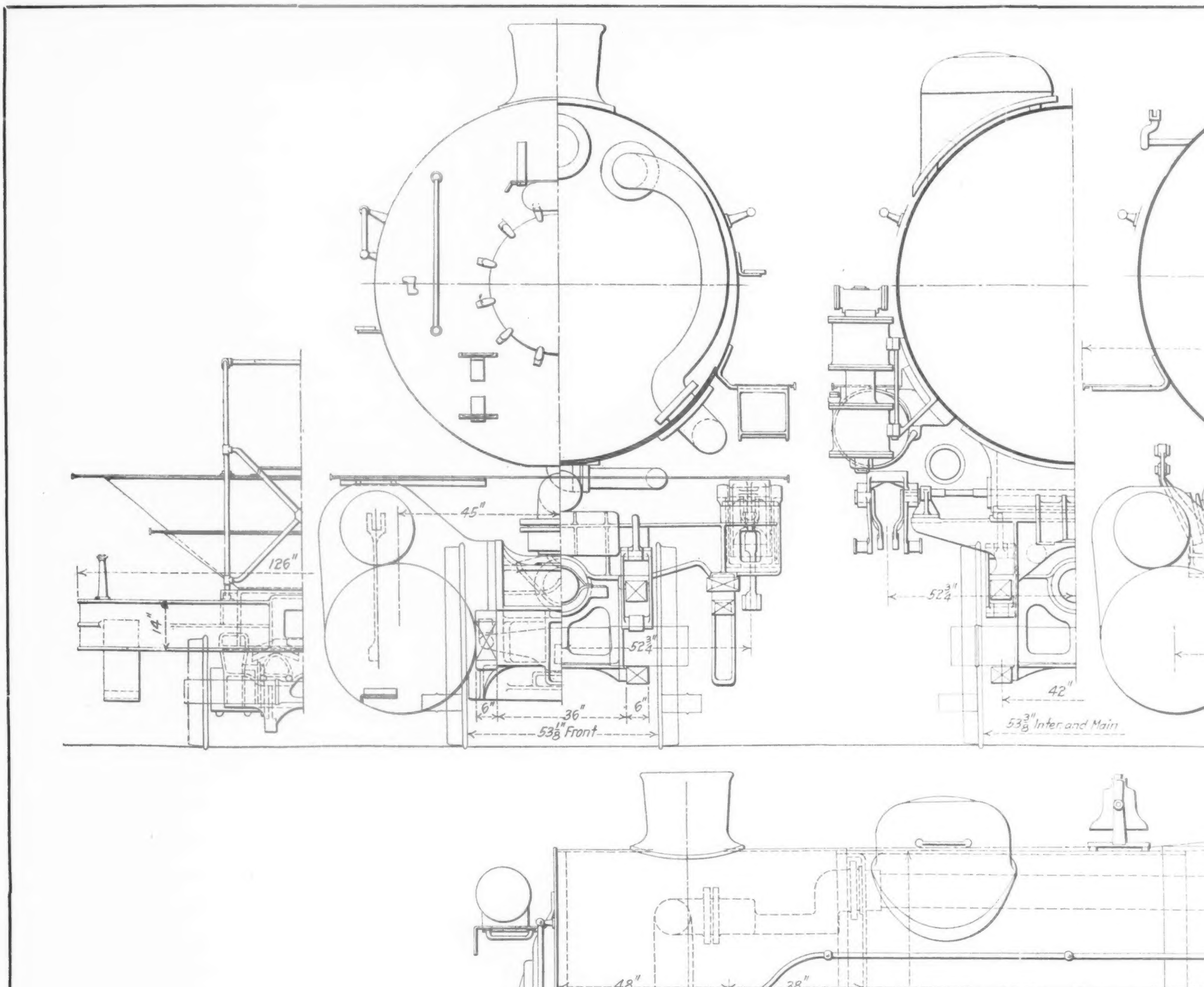
The superheater header is of cast iron, in one piece, and is designed for a 65-element superheater having 2,509 sq. ft. of heating surface. The superheated steam pipes leading back to the high pressure cylinders are fitted with slip joints, and the right hand pipe has a connection, through a suitable cast steel elbow, with the Simplex starting valve. This valve is located in the high pressure cylinder saddle.

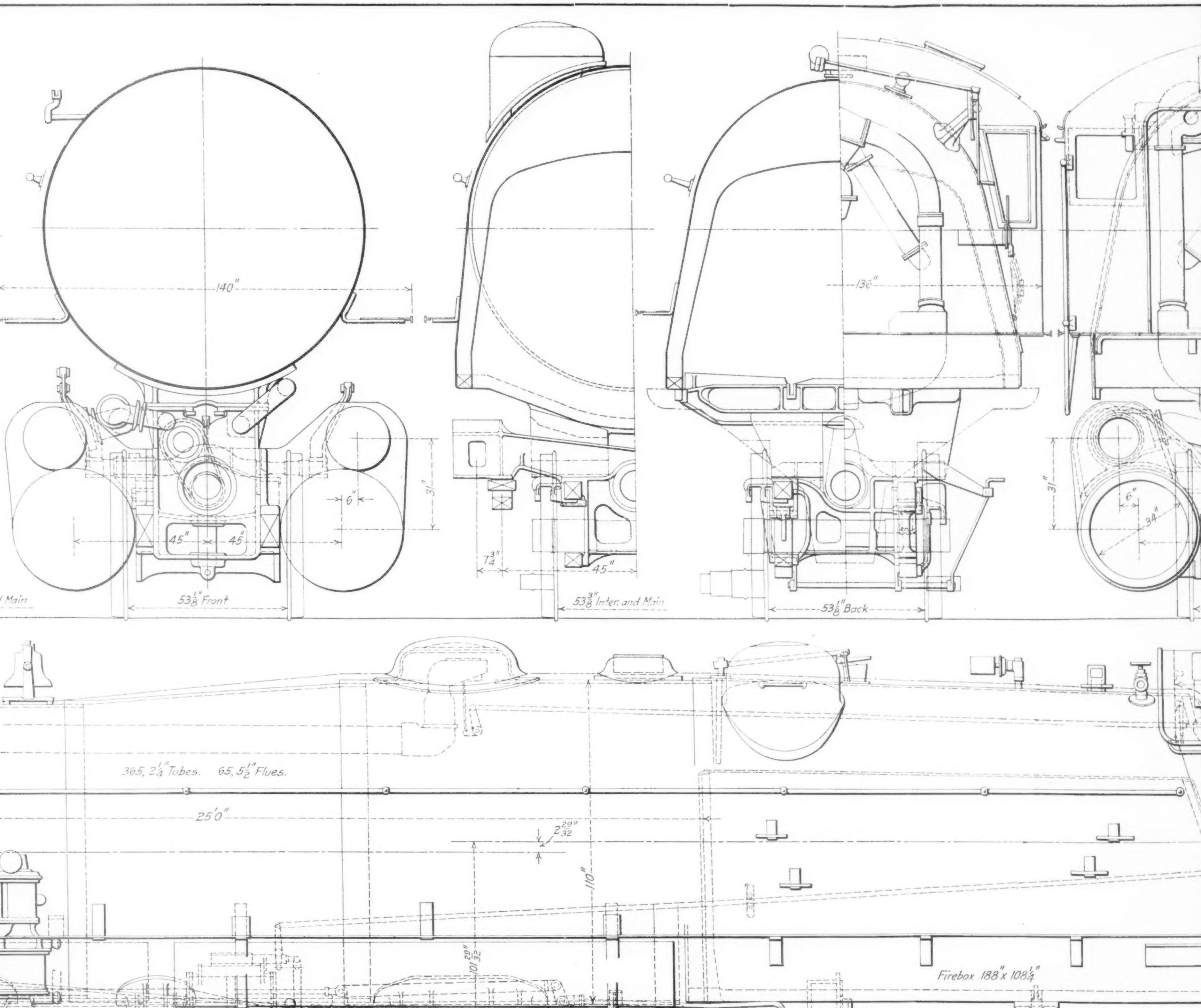
When working compound the two high-pressure cylinders exhaust into a common chamber, which communicates with the front and back receiver pipes. In starting, the intercepting valve is in such a position that live steam enters both the front and back receiver pipes, as well as the high-pressure cylinders; the high-pressure exhaust being conveyed to the smokebox through a separate pipe, which terminates in an annular nozzle surrounding the main nozzle. Both the main and auxiliary nozzles have removable thimbles. The intercepting valve is so arranged that, by admitting steam through a pipe connection from the cab, the locomotive can be worked single expansion at any time. When drifting, saturated steam can be admitted to the high-pressure cylinders through a pipe connected with a lever valve in the cab.

The high-pressure cylinder saddle is made in two pieces, the upper of which is riveted to the boiler shell, while the lower is cored out for the intercepting valve and pipe connections. All six cylinders are cast from the same pattern; they are of vanadium iron, so designed that bushings ¾ in. thick can be applied subsequently if desired. The pistons have dished heads of forged steel, with cast iron bull rings held in place by electrically welded retaining rings. The piston rods are of Nikrome steel, without extensions. Vanadium cast steel is used for the cross-head bodies; they are of the Laird type, and are as light as is consistent with the strength required. The main crank pins are of Nikrome steel, hollow bored, while the main and side rods and main driving axles are of chrome-vanadium heat treated steel. Vanadium steel

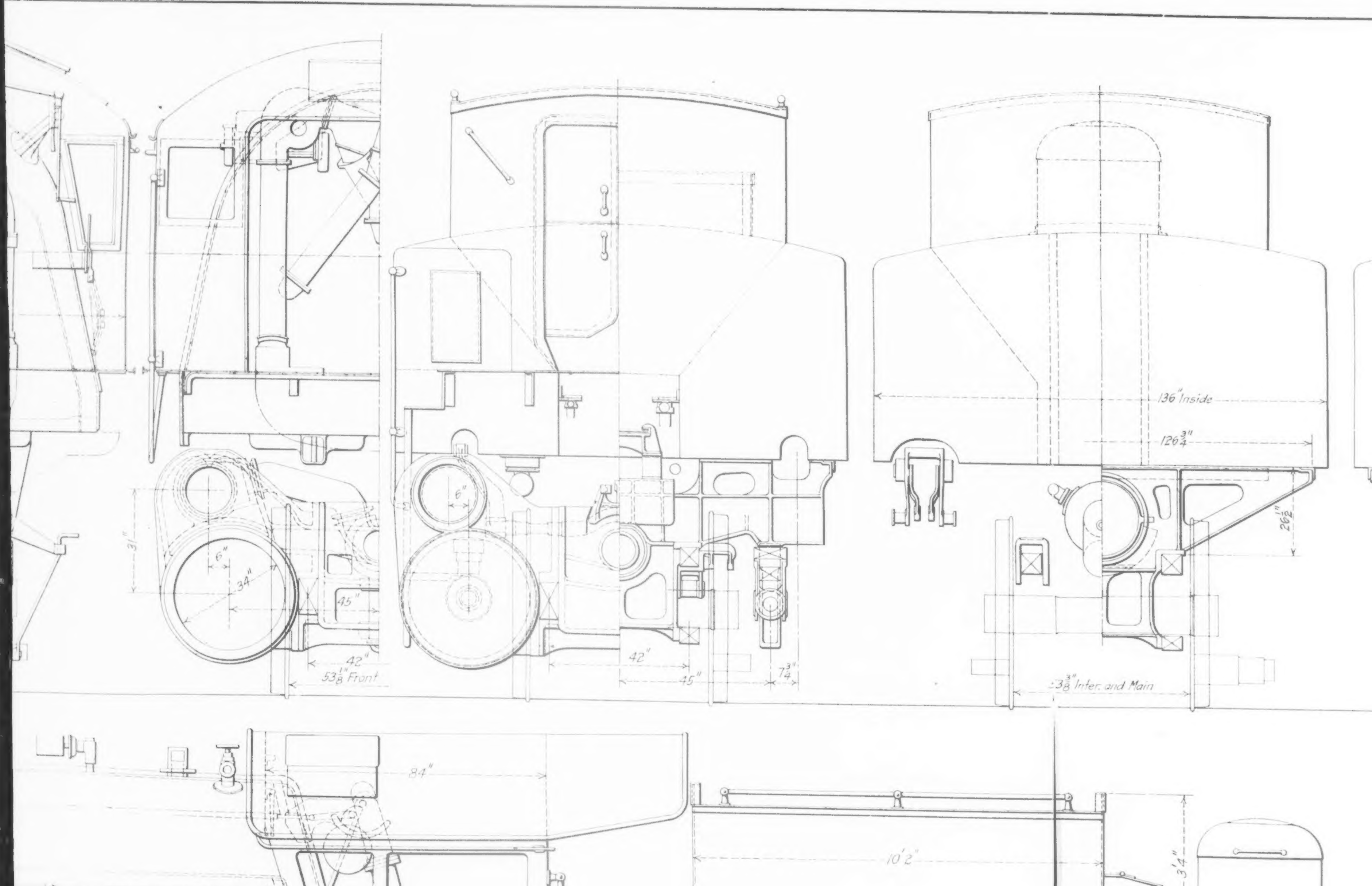


The Virginian Triple Articulated Locomotive

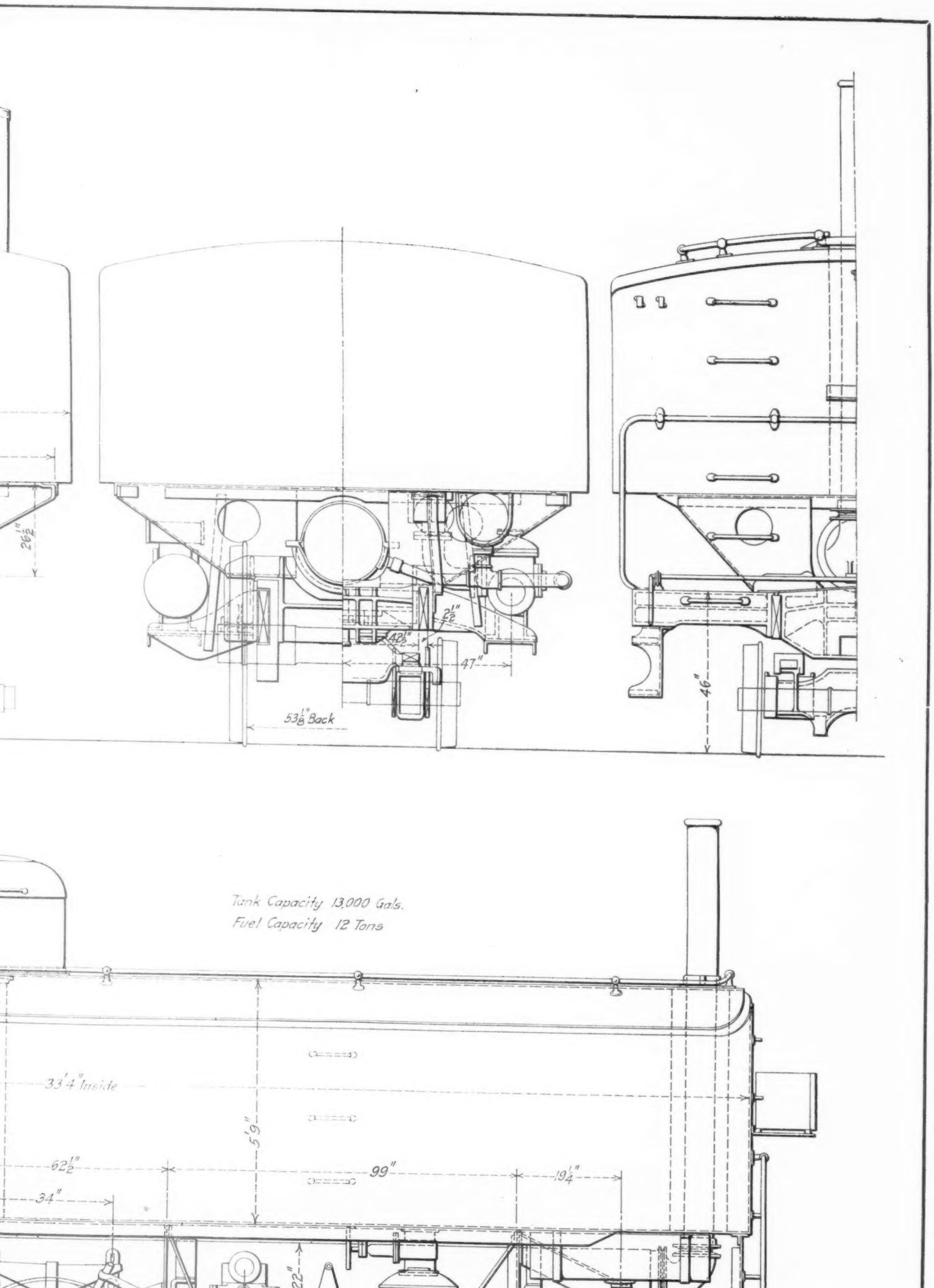

45"
126"
14"
52¾"
6"
36"
6"
53⅛" Front
52¾"
42"
53⅜" Inter and Main
48"
38"
100"
99"
34"
32½"
18½"
2"
34"
Cylinders 34" x 32"
79" Guides
70¼"
48"
59"
61"
61"



Triplex Compound Locomotive Built by the Baldwin Locomotive Works for the Virginian Railway; Total Weight, 8



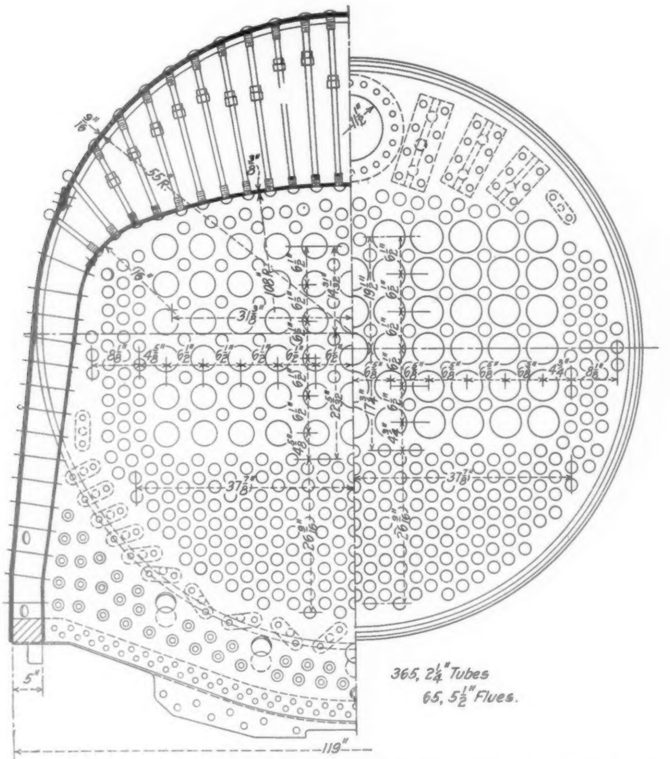
the Virginian Railway; Total Weight, 844,000 lb.; Tractive Effort, 166,300 lb.



Tank Capacity 13,000 Gals.
Fuel Capacity 12 Tons
33'4" Inside
5'9"
62½"
99"
19¼"
34"
22"
57"
49"
141"
72"
77½"
34"
30"
26½"
2½"
43½"
47"
53⅛" Back
46"

is used for the driving tires and also for the springs. The valve motions are of the Baker type, controlled by the Ragonnet power reverse mechanism.

The frames are of vanadium steel castings, 6 in. in width. The radius bars at the two articulated frame connections are attached to horizontal transverse pins, and are fitted with case-hardened spherical bushings which embrace the hinge



Section Through the Firebox and Elevation of the Front Tube Sheet

pins. This construction provides flexibility in a vertical as well as horizontal plane, and prevents binding at the hinge pins when passing over sudden changes in grade or poorly surfaced track. It has been used by the builders in a number of recent Mallet locomotives. The structural details include a number of steel castings of unusual design. The waist bearers supporting the forward part of the boiler barrel, for example, and the three guide bearers are all bolted to both the upper and lower frame rails, and constitute most effective transverse frame braces. The front bumper beam and deck plate are combined in a large steel casting, furnished by the Commonwealth Steel Company and designed to house the Miner A-59 draft gear. This style of draft gear is also used at the back end.

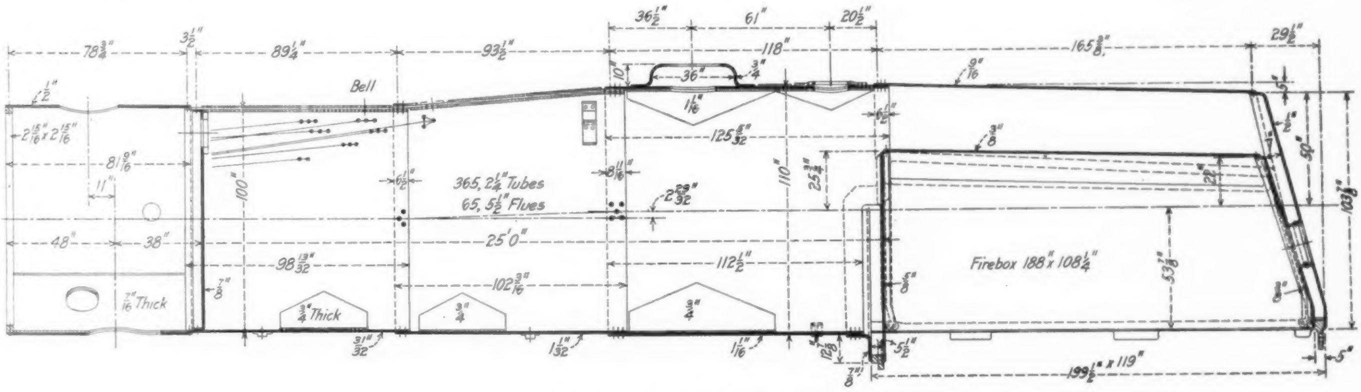
The tank is 33ft. 4 in. long, 11 ft. 4 in. wide and 5 ft. 9 in. deep inside. It has a capacity of 13,000 gallons. The top is rounded to a radius of 22 ft. 1 in. and the top and side sheets are joined by a plate which is bent to a 3-in. radius. This provides a neat finish, and makes it impossible for water to accumulate on top of the tank. Supports for the tank are provided by the guide bearer of the rear engine by two cast steel bearers placed respectively between the second and third and the third and fourth pair of wheels of the rear groups, and by three bearers composed of ½-in. plates, which are placed over the rear frame extensions.

The exhaust steam from the rear cylinders passes through a feed-water heater, which is placed under the tank, and consists of a long drum 22 in. in diameter. The exhaust steam passes through 31 tubes, 2¼ in. in diameter, which traverse the drum, 437 sq. ft. of heating surface thus being provided. The feed-water is handled by a Blake and Knowles piston pump, which is placed between the tank and the heater. The pump is located under the tank, back of the rear driving wheels. This arrangement requires a flexible connection in the steam line leading to the pump, but as only cold water is handled, the pump is far more reliable in service than it would be if placed between the heater and the boiler, where hot water would have to be handled. The locomotive is also provided with two injectors for use in cases of emergency.

The tank is of such length that it extends considerably beyond the rear driving wheel base, and the weight of the overhang is carried by a four-wheel, constant resistance engine truck of the Economy type. This truck has a total swing of 13¼ in., and the load carried by it is equal to the total weight of an express passenger locomotive of 30 years ago. The two-wheel leading truck is of the Economy type also.

Attention should be called to the sanding arrangements used on this locomotive. There are four sand boxes placed right and left over the boiler, two for the forward group of wheels and two for the middle group. Sand for the rear group is carried in a box, which is placed on top of the tank. The pipes from this box are run to the bottom of the tank through two vertical pipes 4½ in. in diameter. The sanders are of the Graham-White "Perfect" type and are 12 in number, six for sanding forward and six for sanding backward. In connection with the sanding equipment, rail washers are placed at each end of the locomotive, and a specially designed valve in the cab controls the supply of sand and washing water simultaneously. When the handle of this valve is turned in one direction, sand is delivered under the front drivers of each group and water is discharged through the washing pipes at the rear; while if the handle is turned in the opposite direction, sand is delivered under the rear drivers of each group and water is discharged through the front washing pipes. Suitable nozzles are also provided for blowing out the sand traps and their pipe connections by means of compressed air. Flange oilers are applied to the front and rear driving wheels in each group.

The cab is roomy and the fittings are conveniently ar-



Boiler of the Virginian Triplex Locomotive

ranged. The front wall of the cab is sloped to follow the inclination of the back-head, in order to provide ready access to the stay-bolts. The cab equipment includes a pyrometer and a low water alarm. The advantage of a power reverse mechanism in simplifying the arrangement of the cab fittings is most apparent in a locomotive of this size.

Where practicable, the railway company's standard details have been used in this locomotive. The driving tires and driving boxes interchange with those of the Class M-C Mikado type locomotives, which are used in heavy freight service on the low grade sections of the line.

The principal data and dimensions are as follows:

General Data	
Gage	4 ft. 8½ in.
Service	Pusher
Fuel	Soft coal
Tractive effort	166,300 lb.
Weight in working order	844,000 lb.
Weight on drivers	726,000 lb.
Weight on leading truck	36,000 lb.
Weight on trailing truck	82,000 lb.
Weight of engine and tender in working order	844,000 lb.
Wheel base, driving	67 ft. 7 in.
Wheel base, rigid	15 ft. 3 in.
Wheel base, total	91 ft. 3 in.
Ratios	
Weight on drivers ÷ tractive effort	4.4
Total weight ÷ tractive effort	5.1
Tractive effort × diam. drivers ÷ equivalent heating surface*	829.3
Equivalent heating surface* ÷ grate area	103.6
Firebox heating surface ÷ equivalent heating surface,* per cent	3.2
Weight on drivers ÷ equivalent heating surface*	64.8
Total weight ÷ equivalent heating surface*	75.3
Volume both cylinders	46.3 cu. ft.
Equivalent heating surface* ÷ vol. cylinders	242.1
Grate area ÷ vol. cylinders	2.3
Cylinders	
Kind	Compound
Diameter and stroke (six)	34 in. by 32 in.
Valves	
Kind	Piston
Diameter	14 in.
Wheels	
Driving, diameter over tires	56 in.
Driving, thickness of tires	3½ in.
Driving journals, diameter and length	11 in. by 13 in.
Engine truck wheels, diameter	30 in.
Engine truck, journals	6½ in. by 14 in.
Trailing truck wheels, diameter	30 in.
Trailing truck journals	6½ in. by 14 in.
Boiler	
Style	Wagon top
Working pressure	215 lb. per sq. in.
Outside diameter of first ring	100 in.
Firebox, length and width	188 in. by 108¼ in.
Firebox plates, thickness	sides, back and crown, ⅜ in.; tube, ⅝ in.
Firebox, water space	front, 5½ in.; sides and back, 5 in.
Tubes, number and outside diameter	365—2¼ in.
Flues, number and outside diameter	65—5½ in.
Tubes and flues, length	25 ft.
Heating surface, tubes and flues	7,689 sq. ft.
Heating surface, firebox	359 sq. ft.
Heating surface, arch tubes	72 sq. ft.
Heating surface, total	8,120 sq. ft.
Superheater heating surface	2,059 sq. ft.
Equivalent heating surface	11,209 sq. ft.
Grate area	108 sq. ft.
Tender	
Water capacity	13,000 gal.
Coal capacity	12 tons

*Equivalent heating surface = total evaporative heating surface + 1.5 times the superheating surface.

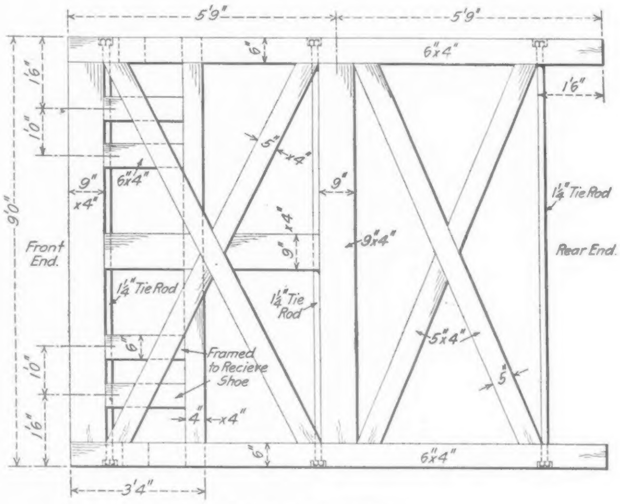
A PILOT SNOW PLOW

BY C. C. LEECH

At this season of the year the removal of snow from the right of way becomes a more or less serious problem, depending on the weather conditions and the locality. Drifting of snow frequently takes place where and when least expected. It therefore becomes important that there should be on hand snow plows which can be easily attached to locomotives.

A snow plow of simple construction is shown in the drawings. A 4-in. by 6-in. oak frame is provided on which is laid 1¼-in. oak flooring, and above this is erected a flanger for pushing the snow to each side. This flanger is covered with No. 10 steel and the space between the end of the flanger and the toe of the plow is covered with ⅜-in. steel plate. The weight of the plow is carried by two hinge joints bolted to the pilot, one over each rail and two yokes bolted to the frame of the plow and bearing against the steel plate bolted onto the face of the bumper beam.

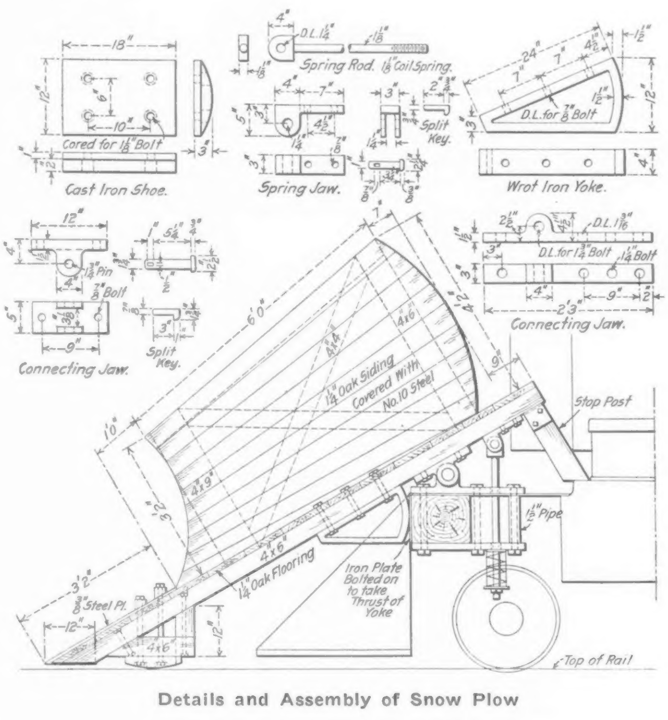
It will be noted there is an iron shoe which is bolted on the frame near the toe of the plow. There are two of these shoes, one above each rail, and while the plow is standing



Snow Plow Frame

free without snow on it, there is a small clearance between the shoes and the rails. The clearance is obtained by means of a rod located at the top of the plow and running down through a strap on the bumper beam. In order that the clearance may be correct a stop post is so located that it will work against any convenient part of cylinder or valve casting.

In putting the plow on a locomotive it is not necessary to



Details and Assembly of Snow Plow

remove the regular pilot as the bearings and yokes are on the outside, over the rails, and do not interfere with the pilot in any way. The front coupler has to be removed, but as it is only held by a pin it can be done in less than a minute.

By keeping the plow on an accessible track during the winter season and having it raised up the proper height by a rail underneath the yoke, it is possible to quickly attach it to a locomotive which has been fitted with hinge joints.

Convention Attendance a Big Asset

Enthusiastic Expressions Received in Prize Letter Competition as to the Practical Benefits Derived

A LARGE number of letters were received in the competition on the Benefits to be Derived from Convention Attendance. Announcement was made in last month's issue of the prize winners. To a man who is closely tied down to the job and has little opportunity of coming in contact with men engaged with similar problems on other roads, the advantages gained from attending a live convention are truly remarkable. Indeed, it is difficu't to understand why the officers and foremen on some roads are not more systematically encouraged to attend conventions. The best thing that could be done in the interests of efficiency and economy would be to order them to do so at the company's expense.

THE VALUE OF CONVENTION ATTENDANCE

(FIRST PRIZE.)

BY F. P. ROESCH

Master Mechanic, El Paso & Southwestern, Douglas, Arizona

A man's value to the company employing him in any position, but more especially in an official or semi-official capacity, depends, first, on his own personal knowledge and ability, and, second, on his capacity to use this knowledge or impart it to others. The faculty of imparting information to others is governed largely by ability to think quickly, clearly, and express oneself concisely—to reason from cause to effect, and conversely from effect to cause, to know what is to be said and how to say it understandingly.

Full knowledge of any one particular subject cannot be grasped by any one individual; but many men all studying a single subject from as many angles will naturally cover the ground more thoroughly than can any one man, regardless of the time and attention he may devote to it. That this fact is fully appreciated by manufacturing, engineering and similar concerns, is manifest by the number of experts, consulting engineers, etc., retained on their staffs.

In the railroad field, however, the question arises, How can each man interested in a certain subject obtain the benefit of the research of others devoting their time and energy along similar lines? Surely no better means could be devised than through mutual interchange of ideas and a full discussion of the various phases of the subject.

We are all more or less bound by environment, and often when a new and troublesome question in operation or maintenance arises, we spend time and money seeking a solution, whereas exactly similar cases may have arisen elsewhere, the remedy has been found and the information available for our use, did we but know where to apply for it.

Here we have the keynote of the value of all conventions—the opportunity of obtaining information first hand, covering many vexing problems which daily confront those in charge of various departments on our railways.

The writer has often "been up against it," so to speak, on matters pertaining to locomotive and train operation, maintenance, tests, inspection, etc., and has never yet failed to find help for his troubles at one of the conventions. In fact, the information obtained has been of such benefit individually, that he has not only paid his own expenses, but in some cases his railroad fare, in order to attend. The conventions have been regarded as an annual post graduate course in his line of work.

The question may be asked, Cannot this information be obtained equally as well from the perusal of the printed proceedings? The answer can be given Yankee fashion: Why do physicians and surgeons who are admittedly at the head of their profession attend clinics and lectures? Books are invaluable where no other means of obtaining information are available, but the most valuable information is obtainable through that intimate personal discussion possible only on the "side lines"—talks that are never published.

Conventions present another educational feature that must not be overlooked, viz., the exhibits. To paraphrase, "An ounce of demonstration is worth a pound of reading." At all present-day conventions can be found modern appliances appertaining to that division of the railroad world under the auspices of which the convention is held, as well as a corps of trained experts to demonstrate and describe their operation. The knowledge so obtainable is in itself alone sufficient to justify attendance, and no one need return home without a full understanding of these devices.

The difference between the man who must remain at home and the one who has the privilege of attending conventions is, the former must frequently grope in the dark to work out his own salvation, while the latter is working in the light of combined and concentrated knowledge ga'ned by the experience of others. Personal experience is a dear teacher. We can learn through the mistakes of others as well as through our own and at much less expense. Is it not therefore good business policy to send men where they can at little cost obtain the benefit of the experience of many men instead of paying for knowledge piecemeal through personal mistakes and personal experience?

BENEFITS I DERIVED FROM THE FOUNDRYMEN'S CONVENTION

(SECOND PRIZE.)

BY R. R. CLARKE

Pittsburgh, Pa.

Conventions are the inventories of progress. They record the advancements of a season. They are great educators. In them we study our composite wants and conditions. We compare notes, exchange opinions, analyze methods and fund the sum total of useful knowledge along specific lines of endeavor.

The American Foundrymen's Association and The American Institute of Metals jointly convened in Cleveland, Ohio, September 11 to 16, 1916. Three features were prominent: practical and technical sessions, plant visitation, and foundry appliances exhibition. The author made this convention a part of his vacation and attended every session. He found it a post-graduate course in experience. Inspiration was in the air. It existed along with an atmosphere of brotherhood, strengthened from association with the best men in the business. The two types of session brought the two types of men close together. Comparison of ideas followed freely; technical men joined in practical discussion lending their basic principles to the elucidation of foundry facts. Similarly, practical men took interest in technical arguments, inquisitive of the practical meaning and application. Technical men expounded in practical terms and details, carrying the thought to its actual foundry application. Better understanding resulted. New ideas sprung forth and old ones took on new features. That was a great benefit. It gave everybody hundreds of little points applicable to daily practice. For instance, in discussing aluminum melting, a technical man stated that aluminum was a carbon absolver. The graphite crucible and the charcoal flux were therefore detrimental. Practical men asked for remedies and got them in detail. Co-ordinating this discussion was a valuable remark from a

man who had obtained 100 aluminum melts from a crucible that had outlived its copper melting usefulness and in which the carbon walls were partially carbon-neutralized.

Papers presented covered the whole field of foundry activity and came from men foremost in the industry. Such subjects as "Twenty-five Years' Experience in a Brass Foundry," "High Pressure Alloys," "Making Thin Walled Castings," "Results of Closer Co-operation Between the Engineer and the Foundry," all from authoritative sources and amplified by free discussion, could not fail to broaden every foundryman present. This whole-hearted co-operation along with the excellent subjects yielded the author his greatest benefit.

Plant visitation consisted in inspection of the representative foundries of the city and afforded the opportunity of seeing how other people do it. Its benefits are too obvious to require comment.

The foundry exhibition afforded a great study. Every related phase was represented, equipment, supply, literature, etc. Life-sized working models, demonstrations, explanations, information, could be seen and had for the asking. We derived invaluable benefit in practice and ideas from the exhibition.

The convention instills within a man a love and appreciation for organization which is a great power. Each "getting together" cements more firmly, and the man attending gets the benefit of the cementing. Maximum benefit from the convention involves a close study of it. The author wrote the Cleveland convention up for a trade paper. He had to study it and sift its proceedings. He realizes full well the results of studying a convention.

Of the many improvements in practice we derived from the convention we submit the following as representative: We presented a paper ourselves on "Gating Non-ferrous Castings." In writing that paper several new ideas came to us. One was that a single gate cut and poured properly would give better results than a half dozen or more combined in running long thin strips. We tried it and were surprised at the high efficiency of the single gate. This single gate weighed about one-tenth as much as the old multiple gate and was much cheaper because of the great loss of high priced metal in melting. We have been using it ever since. We exhibited samples of this gate accomplishment at the convention and other foundrymen present said that they too would discard the multiple in favor of the better and cheaper single gate.

CONVENTIONS—A MIND TONIC

BY E. S. BARNUM*

If you want to be abreast of the times you must make the opportunity to attend some of the mechanical conventions. The young man who has his career ahead of him is the one who can least afford to miss the things that come to him through the attendance of at least one convention each year.

It is a great and only-too-frequent mistake to look at the matter in the light of a great sacrifice of time and money. There's no sacrifice about it. It is the best investment that can be made.

We are in a period of rapid development. A car or locomotive which was adequate a few years ago is now looked upon as antiquated.

What does the future hold?

There is no better way to get an indication of future developments than to attend one of the conventions of the important branches of the mechanical field.

And don't forget that you must be able to work in terms of the future if you would command attention. The past is history and open to all, but the future with great things in store, is quite another matter. Association with the far-sighted, and an ear close to the ground will certainly help in reading the signs of the times.

Only at a convention are you privileged to hear authorities give their opinions on various subjects of general interest. In many cases you have but to step out to the exhibits and see some actual examples of the subjects discussed. The exhibits at some of the conventions are an education in themselves.

Hearing first handed what the leading lights of the railroad mechanical world have to say on the live subjects is like a tonic to an active mind.

We are very careful to keep our physical condition toned up. The mind should be treated just as fairly. A splendid definition for a real live convention would be "a mind tonic."

* This contribution was entered in the competition, but was not considered in making the awards, Mr. Barnum having associated himself with our editorial staff before the awards were made.

WHAT THE AIR BRAKE ASSOCIATION HAS DONE FOR ME

BY W. P. HUNTLEY
General Foreman, Chesapeake & Ohio, Ashland, Ky.

I wish to write on this topic, not for the reason of the prizes offered, but because of the value this association has been to me and to others.

I have been a member of it 19 years, joining at the annual meeting in Nashville in 1897. The association at that time was four years old. It was at a time when air brake information was hard to get. The best and most authentic available descriptive information was contained in what was known as the "little black book" published by the Westinghouse Air Brake Company.

I can remember taking the diagrams and charts that this book contained, and comparing them with the different ports of the brake mechanism. Some of the ports were not clear on the diagrams and in order to trace them out clearly, I found it necessary to blow through the ports or insert several drops of water with an ink dropper and trace the cavities in this way. It was tedious, uphill work, although I can say that the knowledge gained by these methods "stuck."

At the Nashville convention, I was a timid young man, frankly afraid to speak about or on the subjects that were before the convention. I listened, I absorbed, I became interested and enthused. In fact, there was a spirit of earnest interest manifested by all the members and the desire by all to master the details of the troubles, ailments and treatment of the different parts.

In 1898 I was appointed air brake instructor of our company, continuing in the position six years, and was then appointed shop foreman and general foreman at different points on the system. I realized fully what the Air Brake Association was and is to me. From 1897 to the present time, its progress has been great in the way of spreading broadcast knowledge and information that would otherwise be hard to obtain.

It is with a feeling of pride that I note that the Master Mechanics' and Master Car Builders' Associations are recognizing its usefulness as a helpmate to them. The value of the Progressive Questions and Answers is very great, and had the Air Brake Association copyrighted them, its treasury would have been filled to overflowing. But no, it would not do this, stating the information was for the members and the railways the members served. Even when it was clearly evident that other air brake publications were using their "gunpowder," it stuck to its text, believing it best for the common good, for how could the shop repairmen or trainmen be reached otherwise?

I trust to see the day when the Air Brake Association will come fully into its own, when railways will encourage their air brake foremen to attend and join, when railways will purchase copies of the yearly proceedings for the different shops and terminals for the men to read and study, and when the Railroad Y. M. C. A. will carry it as a text book.

THE KIESEL LOCOMOTIVE TRACTIVE EFFORT FORMULA

BY LAWFORD H. FRY

Prof. A. J. Wood, in his article in the December *Railway Mechanical Engineer*, page 627, does considerable service in putting W. F. Kiesel, Jr.'s, formula on record, but it seems to the writer that the formula offered for the tractive power would have a wider practical usefulness if explained more fully. It also seems that this formula can be more readily handled if brought into a slightly different form. The formula is based on the assumption that at running speeds the relation between the mean effective pressure and the initial pressure in the cylinder is given by the equation:

$$P_m = \frac{2\ P_i}{1 + E} \ \ldots\ldots\ldots\ (1)$$

where
P_m = the mean effective pressure in pounds per square inch.
P_i = the initial pressure in pounds per square inch.
E = a calculated quantity which Professor Wood calls the ratio of expansion.

This expansion ratio is found by dividing the weight of a cylinder full of steam at the initial pressure by the weight of steam actually passed through a cylinder at each stroke. In terms of volume, which is the way in which expansions are usually figured, this expansion ratio is found by dividing the cylinder volume by the volume which the steam passed through in one stroke would have at the initial pressure. It is worth noting that this expansion ratio is not the same as that usually calculated from an indicator card, because on the card we deal with only the steam present in the cylinder as steam, while in the present case the steam passed through the cylinder includes all of that lost in the cylinder by initial condensation. In the formula the amount of steam passed through the cylinders is determined by the steaming capacity of the boiler. If the locomotive has H sq. ft. of heating surface each foot of which produces K lb. of steam per hour, the total hourly steam production will be HK lb. The volume of this is $\frac{HK}{W}$ cu. ft., where W is the weight of one cubic foot of steam at the initial cylinder pressure Pi. The volume of one cylinder is $\frac{d^2 l}{4}$ cu. in., and transforming this into cubic feet and multiplying by the number of strokes per hour, the total piston displacement per hour is found to be

$$\frac{110}{3}\ \frac{d^2 l}{D}\ V \text{ cu. ft.}$$

where
d = the cylinder diameter in inches.
l = the piston stroke in inches.
D = the driving wheel diameter in inches.
V = the speed in miles per hour.

The expansion ratio is found by dividing the cylinder volume by the volume of steam produced, or in symbols

$$E = \frac{110}{3} \times \frac{d^2 l}{D}\ V \times \frac{W}{HK} \ \ldots\ldots\ldots\ (2)$$

So far we have followed Professor Wood, merely putting into words what he has given in symbols only, but now a modification of the formula is suggested to bring it into a condensed form, so that in practical work it can be applied with less calculation.

The basis of this is the boiler factor

$$B = \frac{\text{Rated Tractive Effort}}{\text{Total Heating Surface}}$$

The rated tractive effort is calculated from the cylinder dimensions with a mean effective pressure equal to 85 per cent of the boiler pressure, so that

$$B = 0.85\ \frac{P\ d^2 l}{DH} \text{ where}$$

P=the boiler pressure in lb. per sq. in.

Using this to replace the cylinder, driving wheel and heating surface dimensions, equation (2) becomes

$$E = 43\ \frac{B\ V}{K} \times \frac{W}{P} \ \ldots\ldots\ldots\ (3)$$

On the right hand side of this equation we have four factors which bring into account various phases of the design and operation of the locomotive.

(1) *B*, the boiler factor, is dependent on the proportions of the locomotive and its value will depend on whether high speed or low speed is aimed at in the design. It may run from about eight in the case of Atlantic type locomotives to about 15 in the case of Consolidations.

(2) *V* is the speed at the moment under consideration.

(3) *K* is the hourly evaporation per sq. ft. of heating surface.* The value will vary somewhat with the design of the locomotive and with the quality of the steam produced. Professor Wood assumes, in the case he calculates, *K* equal to 10 for a saturated steam locomotive. This is a conservative value, as the Pennsylvania Railroad in the testing plant at Altoona has shown an hourly equivalent evaporation of as high as 18 lb. from and at 212 deg. F. per sq. ft. of heating surface. As this was superheated steam the corresponding actual weight of steam would be about 14 lb. This is a maximum figure and for general practice it would be safe to put

K = 11 for saturated steam.
K = 10 for superheated steam.

If a more general statement is preferred we can say that the heat available for evaporation which can be absorbed per hour per sq. ft. of total heating surface may run as high as 17,500 B.t.u., but can be conservatively estimated as 12,500 B.t.u. in general practice. Professor Woods' figure corresponds to about 11,600 B.t.u.

For any given rate of heat absorption the weight of steam produced will depend on the amount of heat required to produce each pound. This is mainly dependent on the amount of superheat to be given to the steam and is only very slightly affected by the pressure at which the steam is produced. For the present purposes the effect of the pressure can be neglected. The following table is drawn up to show the amount of heat required for the production of one pound of steam at various temperatures.

TABLE I.

1	2	3	4	5
		Weight of steam produced per sq. ft. of heating surface per hour for various rates of heat absorption. (K)		
Degrees of Superheat. Deg. F.	Heat for the production of 1 lb. of steam from feed water at about 70 deg. F. B.t.u.	For 17,500 B.t.u. per sq. ft.	For 12,500 B.t.u. per sq. ft.	For 11,300 B.t.u. sq. ft.
0 (sat.)	1161	15.1	10.8	9.7
50	1193	14.7	10.5	9.5
100	1221	14.3	10.2	9.3
150	1247	14.0	10.0	9.1
200	1272	13.8	9.8	8.9
250	1297	13.5	9.6	8.7

In this table the feed water temperature is assumed to be about 70 deg. F. The three last columns give values for *K* under various conditions of superheat and of heat absorption or steaming capacity. The figures in column 3 apply to a well designed boiler under conditions of maximum steaming capacity and exceed those which can be maintained in service. Those in column 5 apply to a boiler which is not being pushed to its utmost. Column 4 gives figures which are generally applicable for a conservative calculation. In dealing with modern superheater locomotives the superheat should be taken as about 200 deg.

(4) The fourth factor in equation (3) $\frac{W}{P}$, depends only

* The total heating surface is based on actual dimensions and not on the so-called equivalent heating surface. It includes the fire side of the firebox surface and of the arch tubes, if any, the water side of the boiler flues, and the fire side of the superheater elements.

on the quality and pressure of the steam. Its value for various boiler pressures are shown in column 4 of Table II.

TABLE II.

1	2	3	4
P Boiler Pressure. Lb. sq. in.	Degrees of Superheat. Deg. F.	W Weight of 1 cu. ft. of steam at initial pressure. Lb. cu. ft.	$\frac{W}{P}$
160	0	0.384	0.00240
	200	0.290	0.00181
170	0	0.405	0.00238
	200	0.305	0.00179
180	0	0.426	0.00236
	200	0.321	0.00178
190	0	0.447	0.00235
	200	0.337	0.00177
200	0	0.468	0.00234
	200	0.351	0.00176

The values of W are given in column 3. These it must be remembered show, in accordance with the Kiesel formula, the density of the steam at the initial pressure in the cylinder, not at the boiler pressure P. It will be seen that the effect of the pressure on the values of $\frac{W}{P}$ is practically negligible. If we neglect the effect of the pressure and use the mean values as follows:

$$\frac{W}{P} = 0.00236 \text{ for saturated steam.}$$

$$\frac{W}{P} = 0.00178 \text{ for superheated steam.}$$

We can combine these with the values given for K in Table 1 with the results shown in Table 3.

TABLE III.

Values of $43 \frac{W}{KP}$ for saturated and superheated steam under various conditions of steaming capacity. Steaming capacity is expressed as heat absorption in B.t.u. per hour per sq. ft. of total heating surface.

Degree of superheat. Deg. Fahr.	High steaming capacity 17,500 B.t.u.	Average steaming capacity 12,500 B.t.u.	Low steaming capacity 11,300 B.t.u.
0	0.0066	0.0092	0.0102
200	0.0055	0.0077	0.0091

In this table it will be seen that the co-efficient 43 has been combined with the factors W, P and K, which depend on the quality of the steam, and when this has been done equation (3) for the expansion ratio E can be used in the form given below for calculating the tractive effort for general purposes:

$$E = 0.0092\ B\ V \text{ for saturated steam.}$$
$$E = 0.0077\ B\ V \text{ for superheated steam.}$$

This brings equation (1) for the mean effective pressure into the simple form given below:

$$P_m = \frac{2\ P_i}{1 + 0.0092\ B\ V} \text{ for saturated steam .... (1 A)}$$

$$P_m = \frac{2\ P_i}{1 + 0.0077\ B\ V} \text{ for superheated steam .... (1 B)}$$

The calculation required in using this in practical work can be still further reduced by eliminating the pressures and getting an expression for the running tractive effort at any speed in terms of the rated tractive effort. To do this we note that Pi is the initial cylinder pressure which Professor Wood gives as 10 lb. per sq. in. less than the boiler pressure. This is based on the Pennsylvania Railroad experiments with 205 lb. per sq. in. boiler pressure, and to simplify matters we may write $Pi = 0.95\ P$ where P is the boiler pressure. Then if Tv be the tractive effort at the speed of V miles per hour, and Tr be the rated tractive effort with the assumed mean effective pressure of $0.85\ P$, we have Tv is to Tr as PM, the mean effective pressure at speed, is to $0.85\ P$. If this be combined with equations (1A) and (1B) we have:

$$\frac{T_v}{T_r} = \frac{2.24}{1 + 0.0092} \text{ for saturated steam .... (1 C)}$$

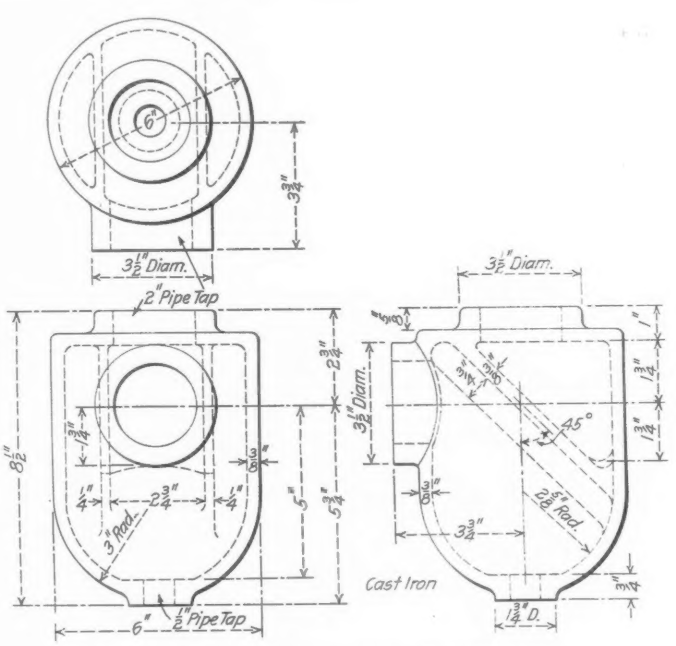
$$\frac{T_v}{T_r} = \frac{2.24}{1 + 0.0077} \text{ for superheated steam .... (1 D)}$$

The equation in this form can be very readily applied in any given case. The rated tractive effort Tr and the total heating surface H being known, the boiler factor B is found by dividing the first of them by the second, and to find the running tractive effort at any speed it is only necessary to insert this boiler factor and the value for the rated tractive effort together with the speed required, in either equation (1C) or (1D), according as the locomotive uses saturated or superheated steam.

EXHAUST SEPARATOR FOR HEADLIGHT SERVICE

BY L. ERNEST

On engines where the headlight turbine is located in front of the cab on top of the boiler, trouble has been experienced with the condensed steam from the exhaust pipe freezing on top of the cab in cold weather. This has been overcome by the application of a separator, which is shown in the accompanying illustration. It is made of cast iron and contains a baffle plate against which the steam from the turbine strikes. What moisture is in the steam is caught on this plate and passes out through the opening on the side, while the steam passes up through the small tapped hole at the top. This arrangement has been found to be entirely satisfactory and is of decided advantage where long exhaust pipes are used.



Exhaust Steam Separator for Headlight Service

SAFETY STANDARDS FOR CRANES.—It is particularly opportune that at a time when shops are turning their attention toward increased facilities, the American Society of Mechanical Engineers should propose a code of safety standards for cranes. This proposed code, presented before the annual meeting in New York City during December, was drafted by a committee representative of the various interests involved and is for the consideration of the sub-committee on the protection of industrial workers. It covers such details of general construction as the factors of safety, materials of construction, clearance between crane and overhead trusses, buildings, columns or other stationary structures, switchboard wiring and other electrical equipment, and various safety devices. There is also a section devoted to the operation of cranes, containing rules for operators, floormen and repairmen.

WALSCHAERT VALVE GEAR DESIGN

Mathematical Determination of the Proportions of Moving Parts to Meet Locomotive Conditions

By H. A. WEIS

IN the design of a new application of the Walschaert valve gear cut-and-try methods are usually employed to a considerable extent. Where an adjustable model is available it is usually the practice to set this up to meet the conditions imposed by the design of the locomotive, and by trial determine the proportions of the various parts to give the desired valve motion. With the following system a complete layout of a new gear may be worked out in a few hours' time; it involves the use of either analytical or graphic methods in proportioning the moving parts and proceeds directly from one end of the gear to the other, starting with the combination lever. The principle involved is, of course, the same whether the gear is for inside or outside admission valves, but the application is slightly different.

In Fig. 1 is shown the layout of a gear for inside admission valves. As in any method, the first requirement is to casing and the cylinder center plus one-half the stroke plus 4 in. Draw a vertical line HH^1 through F, this line being the center line of the combination lever with the crosshead in mid-position and the link block on center.

Proportions of the Combination Lever.—The proportions of the combination lever are determined by the following formula (see Fig. 2), assuming $V = 4$ in.

$$\frac{R}{C} = \frac{L}{V}$$

in which

R = Crank radius.
C = Lap + lead.
L = Length of combination lever.
V = Distance between radius rod and valve stem connections.

If the combination lever becomes too short, increase V by $\frac{1}{4}$ in.; if it becomes too long, shorten V by $\frac{1}{4}$ in. Lay out

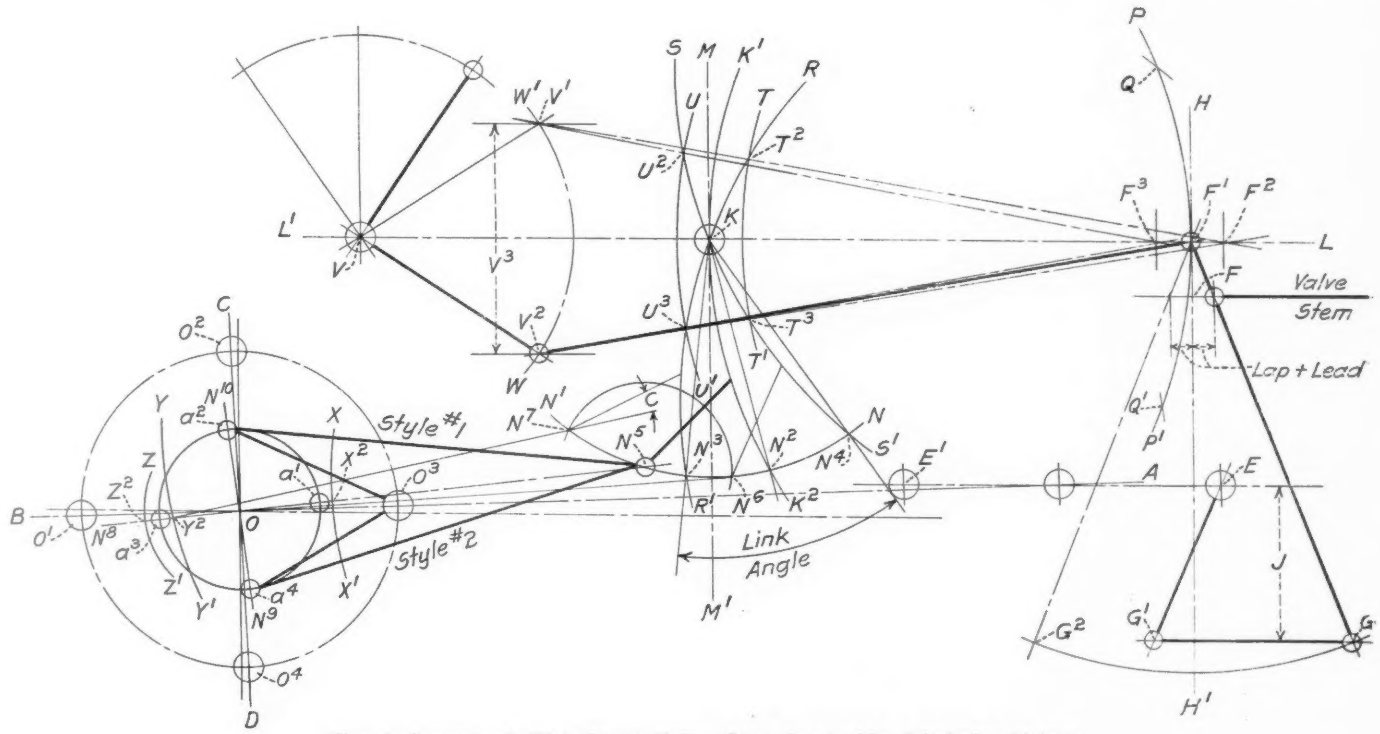


Fig. 1—Layout of Walschaert Valve Gear for Inside Admission Valves

lay out all basic center lines, such as the center lines of the cylinders and driving wheels, and also to locate all limiting points fixed by the boiler, frames, cylinder heads, casings, guides and guide yokes. For the greatest convenience a scale of three inches to the foot should be used. Draw a line AB through the center of the crosshead in mid-position and the center of the main driving wheel, O. Next draw a line, CD, at right angles to AB through O; with O as a center and a radius equal to one-half the stroke draw the crank circle, cutting lines AB and CD at the points O^1, O^2, O^3 and O^4. Points O^1 and O^3 are the correct dead centers and the other two points are the quarter positions of the main crank pin. With a radius equal to the main rod length and O^1 and O^3 as centers, cut the crosshead path at E and E^1, these points being the position of the crosshead at the dead centers. Locate point F to the left of the vertical center line of the cylinder by an amount equal to the distance between the cylinder head the combination lever on the drawing as shown in Fig. 1, point F and line $H H^1$ determining its location.

If the design is for an outside admission valve a combination lever of the type shown in Fig. 2A is required. The same formula is used with the exception that

L = Length of combination lever — V.

Union Link and Crosshead Arm.—The extreme positions of the lower end of the combination lever are shown at G and G^2. In these positions the union link should be horizontal. First determine J, the distance between the center line of the crosshead and the union link connection, as follows (see Fig. 3):

$$J = \sqrt{L^2 - R^2} - (E + V)$$

in which

E = Vertical distance between steam chest and cylinder centers.

For inside admission valves, if J should become less than

$12\frac{1}{2}$ in. lengthen the combination lever; if more than 16 in. shorten the combination lever. For outside admission valves J should not be less than 14 in. nor greater than 18 in.

The length of the union link may then be determined by the following formula.

$$C = \sqrt{A^2 + B^2}$$

in which

C = Length of union link.
A = Distance between crosshead arm connection and center line of combination lever in mid-position.
B = Vertical distance between crosshead arm connection and the lower end of the combination lever (= L — V — E — J).

Assume A as about 20 in. If this brings point G^1 more than 10 in. either side of the crosshead center make A shorter and recalculate the length of the union link. This should not be more than 22 in. nor less than 15 in.

termined as follows: Lay off $O\ D$ equal to R, the crank radius. With O as a center and a radius equal to A, one-half the valve travel, draw a semicircle, as shown by the full line. Draw $E\ F$ perpendicular to $O\ D$ through O and lay off the distance C, equal to the lap plus the lead, to the left of O. Erect a perpendicular at H cutting the valve circle at G and draw line $D\ G$, cutting line $E\ F$ at K. The distance $O\ K$ is equal to B, one-half the required travel of point F^1, Fig. 1. Stated as a formula which may be applied without the use of the drawing board,

$$B = \frac{R\sqrt{A^2 - C^2}}{R - C}$$

For outside admission valves the graphic solution is shown in Fig. 5*A*. This differs from the Fig. 5, in that $O\ H$ is laid

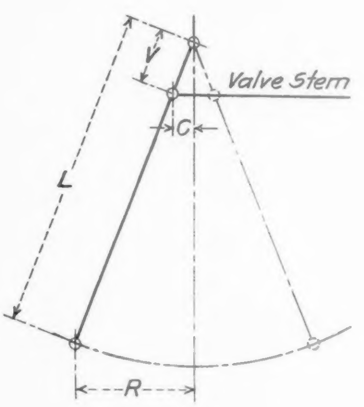


Fig. 2

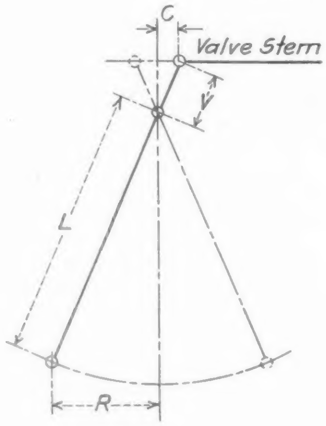


Fig. 2A

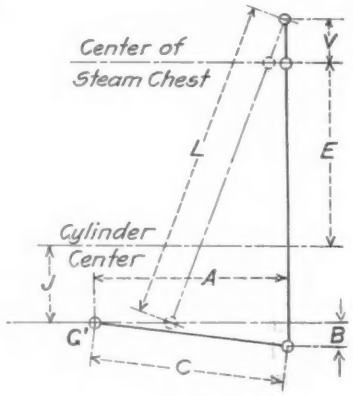


Fig. 3

Fig. 2—Combination Lever for Inside Admission Valves. Fig. 2A—Combination Lever for Outside Admission Valves. Fig. 3—Length of Crosshead Arm and Union Link

Valve Travel.—In ordinary cases the valve travel equals twice the lap plus twice the port opening. However, this does not give sufficient valve travel for the cut-offs desired on locomotives; a valve travel is to be used which gives about 88 per cent to 90 per cent cut-off, which is necessary to start a heavy train. Construct a valve diagram as shown in Fig. 4, finding the valve travel for the desired cut-off. Referring to the diagram:

AB = Valve travel.
AK = Lead.
OL = Lap.
OG = Exhaust lap, if used.
LP = GH = Width of steam port.
OS = Crank position when valve opens.
OC = Crank position at cut-off.
Z = Crank angle at maximum valve travel.

The width of port opening for any desired position of the crank is the distance measured radially from center O between the lap circle OL and the valve circle $OUFW$, the maximum opening being maintained from V to W. The width of port opening, during exhaust is similarly indicated by the shaded portion $G\ X\ H\ Y$.

When laying out valve diagram assume about 6 in. valve travel. If cut-off is less than 88 per cent increase the valve travel by $\frac{1}{4}$ in. With the assumed valve travel and the lap and lead known, draw $S\ C$ tangent to the lap and lead circles. If exhaust lap is used draw $E\ D$ parallel to $S\ C$ and tangent to the exhaust lap circle. If the exhaust is line and line draw $N\ M$ through O parallel to $S\ C$. Draw $C\ R$ perpendicular to $A\ B$. Then the

$$\text{Per cent maximum cut-off} = \frac{AR}{AB} \times 100.$$

The valve travel is obtained from the link and crosshead movements combined, and its amount has a direct effect on the amount of movement which must be obtained from point F^1, Fig. 1. In Fig. 5 is shown a graphical solution of the movement of F^1 for inside admission valves. This is de-

out to the right instead of to the left of O. The formula then becomes

$$B = \frac{R\sqrt{A^2 - C^2}}{R + C}$$

Link and Link Angle.—The rise of the link block should

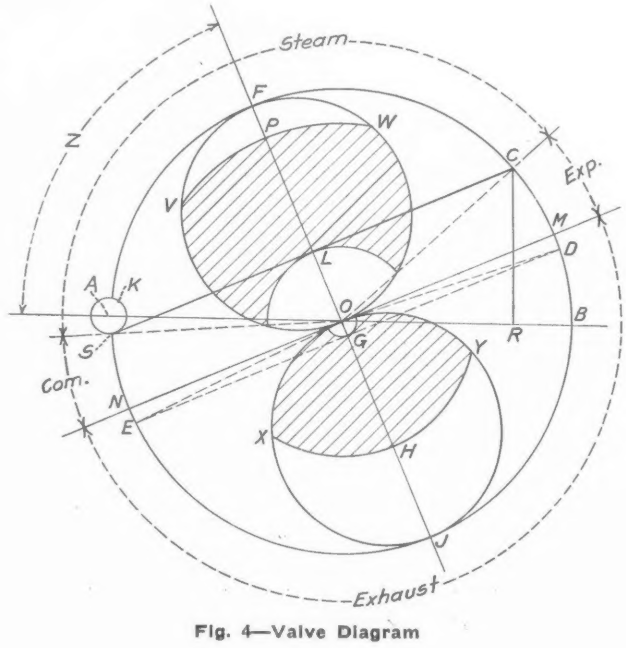


Fig. 4—Valve Diagram

be made about 9 in., which is common practice, but can be increased to $9\frac{1}{2}$ in., maximum, beyond which the link angle becomes too great. Having found the travel of point F^1

(Fig. 1), find the link angle as shown in Fig. 6, in which

D = ½ link angle.
K = Travel of F^1 (Fig. 1) = 2 × B (Fig. 5).
Y = Lift or drop of the link block.
S = Y + 3 in. = link clearance.

The following relations will readily be seen to exist:

$$X = \frac{.5\ K}{\text{Tan D}} \text{ and } Y = \frac{.5\ K}{\text{Sin D}}$$

The link angle ordinarily should not be greater than 45 deg., while the lift of the link block is usually about 9 in. for inside admission valves and 8 in. for outside admission valves. In laying out a new gear solve for X or Y first, assuming a link angle of 45 deg. Should the required valve travel be unusually large, the link angle may be increased to

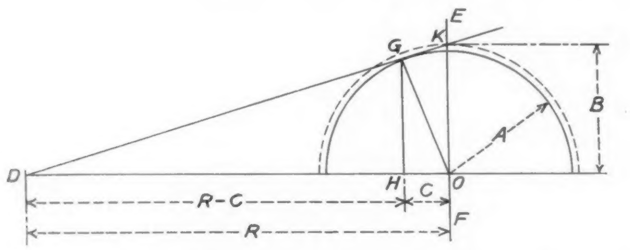


Fig. 5—Travel of F^1, Fig. 1, for Inside Admission Valves

a maximum of 50 deg., and the link block lift increased to 9½ in. These limits should never be exceeded. When a case of this kind presents itself, first increase the link block lift to 9½ in. and determine the link angle. Should the latter exceed 50 deg. it will be necessary to decrease the valve travel by an amount necessary to keep the link angle within the above limit.

Having found the link angle, locate the link center K, Fig. 1, about halfway between the vertical center line of the main wheel and the vertical line through point F, Fig. 1, on line $L\ L^1$, passing through point F^1 and parallel to the horizontal center line of drivers. Since point F^1 may be rather high on engines having cylinders of large diameter and inside admission valves, or may be low where outside admission valves are used, point K may be located either

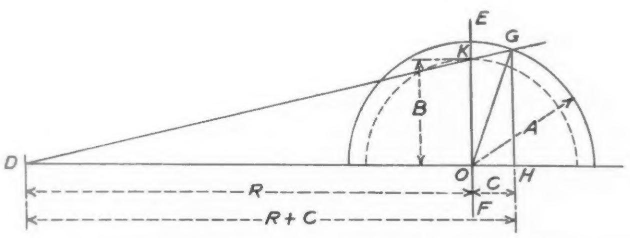


Fig. 5A—Travel of F^1 for Outside Admission Valves

lower or higher than point F^1, as the case may be. This will not affect the gear seriously, provided the drop or rise of the line $F^1\ K$ from the horizontal does not exceed 1 in 12.

Draw a line $M\ M^1$ through K at right angles to $L\ L^1$, the center line of the radius bar. Line $M\ M^1$ is the center line of the link and, in all cases, must be at right angles to $L\ L^1$. With K as a center and a radius equal to the link foot radius (the vertical distance between the link center and the horizontal wheel center minus 3 in.) draw an arc $N\ N^1$. With a radius equal to $F^1\ K$ (the length of the radius bar) and F^1 as a center, draw arc $K^1\ K^2$, cutting $N\ N^1$ at N^2. With K as a center and the same radius draw $P\ P^1$, through point F^1. Draw a line through $K\ N^2$ and on this line as a center lay off the link angle $N^3\ K\ N^4$. With N^3 as a center and a radius equal to $F^1\ K$ cut arc $P\ P^1$ at Q^1; with the same radius and N^4 as a center cut arc $P\ P^1$ at Q. With the same radius and $Q\ Q^1$ as centers, draw arcs $R\ R^1$ and $S\ S^1$, these arcs being the center lines of the link in its extreme positions. Lay off distance B (Fig. 5), each side of F^1, locating points F^2 and F^3. With a radius equal to $F^1\ K$ and $F^2\ F^3$ as centers, draw arcs $T\ T^1$ and $U\ U^1$, cutting the center lines of the link in its extreme positions at points $T^2\ T^3$ and $U^2\ U^3$. These points locate the center of the link block in extreme positions for both forward and reverse motions.

Radius Bar Suspension.—Various forms of radius bar suspensions are used in practice, the two principal types being shown in Fig. 1 and Fig. 8, respectively. In laying out the suspension shown in Fig. 1, locate point V about 31 in. to the left of K on line $L\ L^1$. This distance will provide the proper clearance for the radius bar and radius bar lifter. With a radius of 19 in. (the maximum length of reverse shaft

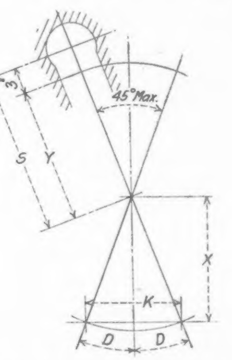


Fig. 6—Length and Angle of the Link

arm when distance $K\ V$ = 31 in.) and V as a center, draw arc $W\ W^1$, this line being the path of the radius bar lifter. Draw lines through points $F^2\ T^2$, $F^2\ T^3$ and $F^3\ U^2$, $F^3\ U^3$, cutting arc $W\ W^1$ at V^1 and V^2. If the two lines do not in each case cut line $W\ W^1$ at a common point, place points V^1 and V^2 half way between the actual points of intersection at top and bottom respectively. Distance V^3 between the two points just found is the throw of the reverse shaft radius

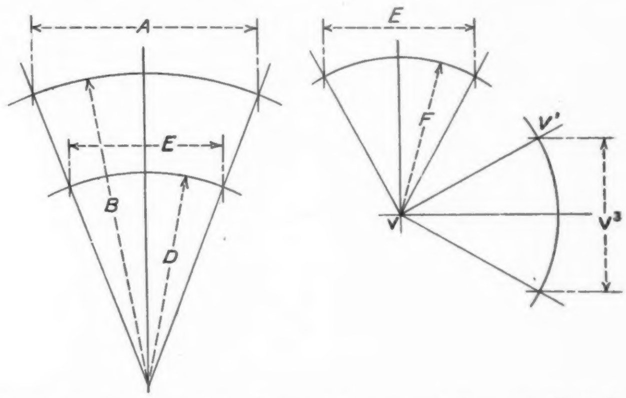


Fig. 7—Proportions of the Reverse Lever and Reverse Shaft Arm

bar connection. Proportion the reach rod arm by the formula (Fig. 7)

$$\frac{E}{F} = \frac{V^3}{VV^1}$$

in which $V\ V^1$ and V^3 are known and

E = Throw of reach rod arm.
F = Length of reverse shaft reach rod arm.

The proportion of the reverse lever must be such that

$$\frac{A}{B} = \frac{E}{D}$$

E depending on the length of F above, and

A = Throw of the reverse lever at the quadrant.
B = Radius of the quadrant.
D = Radius of the reach-rod connection.

In Fig. 8 the radius bar is shown suspended by a link from the reverse shaft arm, the center of the shaft being lo-

cated forward of the suspension. In laying out this type of suspension draw arcs $V\,V^1$ and $V^2\,V^3$ (see Fig. 8) with a radius equal to $F^1\,K$ plus 9 in. and with points F^2 and F^3 as centers. Draw lines through points $F^2\,T^2$ and $F^2\,T^3$, cutting arc $V\,V^1$ at points W and W^2; also draw lines through $F^3\,U^2$ and $F^3\,U^3$, cutting arc $V^2\,V^3$ at W^1 and W^3. With a radius of 12 in. (the length of the suspension link) and

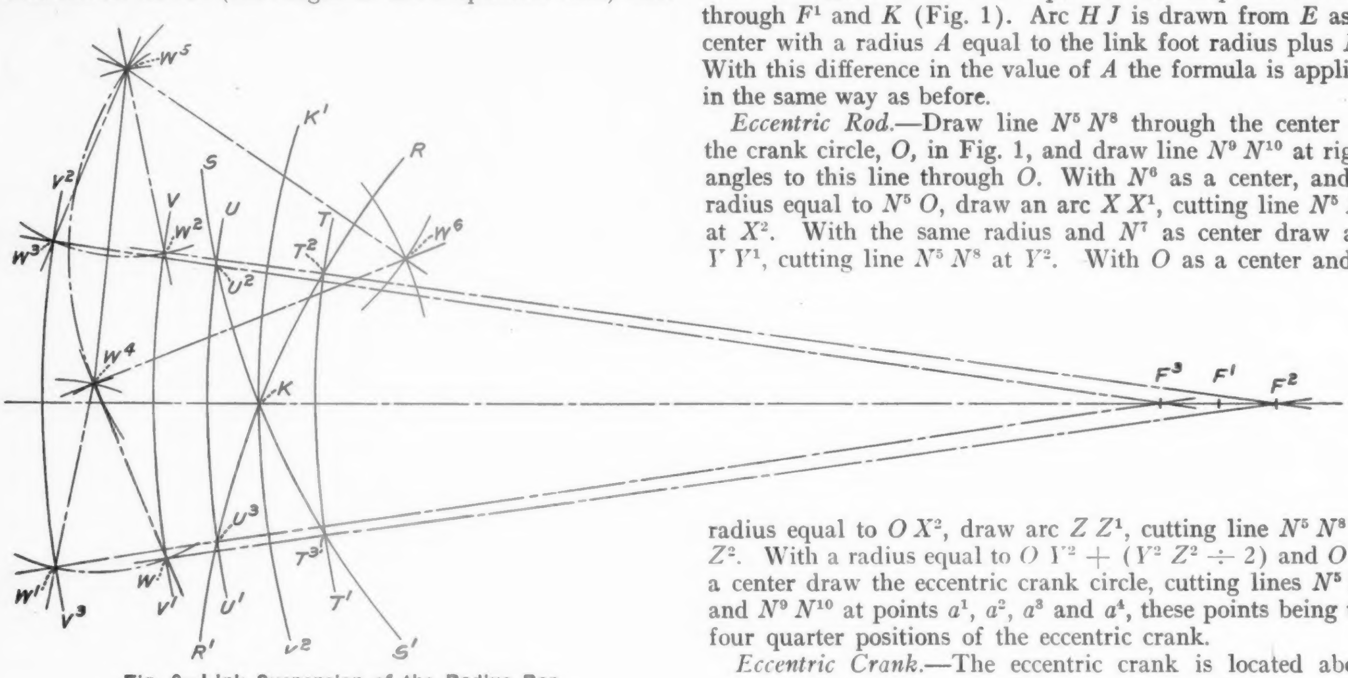


Fig. 8—Link Suspension of the Radius Bar.

W, W^1, W^2 and W^3 as centers, strike arcs, the intersections of which locate the points W^4 and W^5. With a radius of 21 in. and W^4 and W^5 as centers, locate point W^6, the center of the reverse shaft. Proportion the reverse shaft reach rod connection as shown in Fig. 7, using distances $W^4\,W^5$ and $W^5\,W^6$ as the known quantities.

Link Foot Offset.—In Fig. 9 is shown the graphical solution of the link foot offset. This is laid out on the horizontal line $D\,E$, the length of which is equal to the length of the radius bar. Draw $F\,G$ perpendicular to $D\,E$ through E and

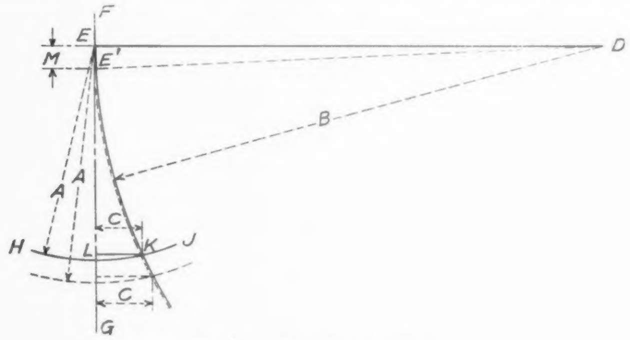


Fig. 9—Link Foot Offset

with this point as a center strike the arc $H\,J$, using the link foot radius. With D as a center and a radius equal to the length of the radius bar draw an arc intersecting $H\,J$ at K. Then $K\,L$ equals the amount of the link foot offset. If

A = Link foot radius
B = Length of the radius bar
C = Link foot offset

the above relation may be expressed by the formula

$$C = \frac{A^2}{2\,B}$$

Lay off the distance C to the left of line $M\,M^1$ (Fig. 1), locating point N^5 on arc $N\,N^1$. With N^5 as a center and $N^2\,N^3$ as a radius, locate points N^6 and N^7, which are the extreme positions of the link foot.

The above procedure is based on the assumption that the line $L\,L^1$ (Fig. 1), is parallel to the center line of the drivers. If the link center should be located below this line, proceed as indicated by the broken lines in Fig. 9. In this case $D\,E$ is horizontal and $D\,E^1$ represents the slope of the line through F^1 and K (Fig. 1). Arc $H\,J$ is drawn from E as a center with a radius A equal to the link foot radius plus M. With this difference in the value of A the formula is applied in the same way as before.

Eccentric Rod.—Draw line $N^5\,N^8$ through the center of the crank circle, O, in Fig. 1, and draw line $N^9\,N^{10}$ at right angles to this line through O. With N^6 as a center, and a radius equal to $N^5\,O$, draw an arc $X\,X^1$, cutting line $N^5\,N^8$ at X^2. With the same radius and N^7 as center draw arc $Y\,Y^1$, cutting line $N^5\,N^8$ at Y^2. With O as a center and a radius equal to $O\,X^2$, draw arc $Z\,Z^1$, cutting line $N^5\,N^8$ at Z^2. With a radius equal to $O\,Y^2 + (Y^2\,Z^2 \div 2)$ and O as a center draw the eccentric crank circle, cutting lines $N^5\,N^8$ and $N^9\,N^{10}$ at points a^1, a^2, a^3 and a^4, these points being the four quarter positions of the eccentric crank.

Eccentric Crank.—The eccentric crank is located above

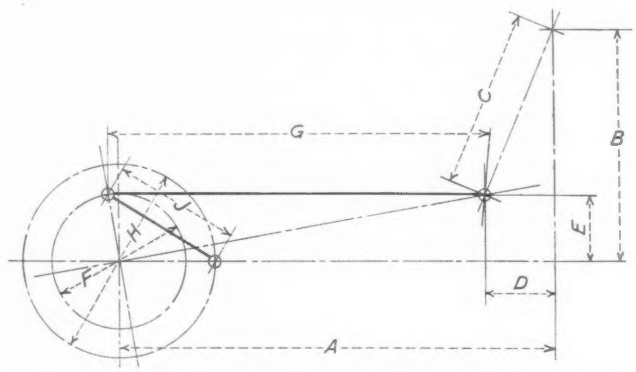


Fig. 10—Lengths of Eccentric Rod and Crank; the Latter Trailing

center O, the crank pin being on the forward dead center, when the reach rod connects above point V, Fig 1, and below point W^6, Fig. 8, (see style 1, Fig. 1). It is located below

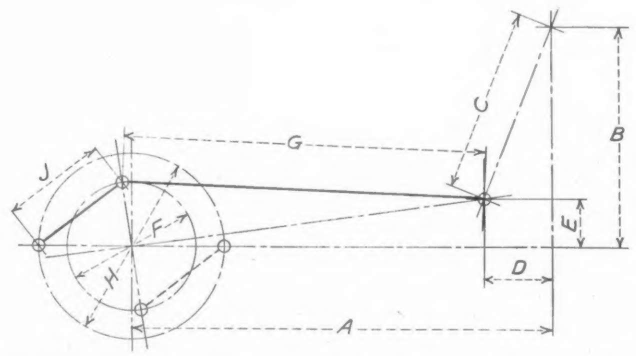


Fig. 10A—Lengths of Eccentric Rod and Crank; the Latter Leading

center O when the reach rod connects below point V and above point W^6 (see style 2, Fig. 1).

For outside admission valves the positions are reversed.

Draw a line through O^3 and a^2 or O^3 and a^4, as the case may be, this line being the center line of the eccentric crank.

The length of the eccentric rod and crank may be scaled from the drawing, or they may be calculated, Fig. 10 showing the geometrical relations on which the calculations for Style 1, Fig. 1, are based. If

A = Horizontal distance between main wheel and link centers
B = Vertical distance between wheel and link centers
C = Link foot radius
D = Link foot offset
E = Distance from the center line of the drivers to the link foot connection (link in central position)
F = Diameter of eccentric crank circle
G = Length of eccentric rod
H = Diameter of the crank pin circle
J = Length of the eccentric crank

the length of the eccentric rod is

$$G = \sqrt{(A - D)^2 + E^2 + \tfrac{1}{4} F^2}$$

The distance from the wheel center line to the link foot connection is

$$E = B - \sqrt{C^2 - D^2}$$

The length of the eccentric crank is

$$J = \sqrt{\tfrac{1}{4} H^2 + \tfrac{1}{4} F^2} + \frac{E}{\tfrac{1}{2} F (A - D)}$$

The length of the eccentric rod is correct when $a^1N^6 = a^3N^7 = a^2N^5 = a^4N^8$.

For Style 2, Fig. 1, the length of the eccentric rod remains unchanged, as may be seen by referring to Fig. 10A. The length of the eccentric crank, however, is shortened, its value being

$$J = \sqrt{\tfrac{1}{4} H^2 + \tfrac{1}{4} F^2} - \frac{E}{\tfrac{1}{2} F (A - D)}$$

Care should be taken that the eccentric rod does not form an angle less than 10 deg. at C in position $a^3 N^7$ (Fig. 1). If this angle should be smaller, the link foot offset can be slightly reduced without affecting the gear seriously. If this becomes necessary the length of the eccentric rod and crank must be recalculated.

MECHANICAL DESIGN OF ELECTRIC LOCOMOTIVES

A paper on this subject was presented by A. F. Batchelder before the railroad section of the A. S. M. E. at the annual meeting in New York. An abstract was published on page 558 of the November, 1916, issue.

DISCUSSION

C. H. Quereau, superintendent electrical equipment, New York Central—The operating advantages gained by having electric locomotives designed to operate in either direction are of such great importance that means must be found to provide satisfactory designs to meet this condition. The chief difficulty with present double end locomotives is the oscillation of the trailing truck which Mr. Batchelder proposes to prevent by the introduction of resistance against swivelling. This scheme is practical and has been so demonstrated, but it results in increased flange wear, at least when the center of gravity is low.

I am particularly interested in that the item of "reliability in service" has been given an important place in the list of requirements for electric locomotives. This is a feature which quite commonly is omitted in a discussion of this kind. On railroads which run through a sparsely settled country with comparatively few trains per day, a train delay of half an hour may be of comparatively little importance, but in eastern territories, especially around the large cities, a delay of a few minutes will upset the smooth operation of the railroad for hours and the effect of it will reach back on the line for 150 miles. It is my opinion that the prevention of such delays justifies a considerable increase in first cost, and also that such maintenance methods should be employed that will prevent, as far as possible, delays to traffic. It is decidedly poor policy to reduce maintenance costs if by so doing the result is increased traffic delays.

In my judgment Mr. Batchelder very wisely considers the "cost of maintenance of permanent way" of more importance than "cost of maintenance of locomotives." I believe, however, that if the cost of maintenance of way is no greater under electric than steam operation, it would be satisfactory and would not be used as an argument against electrification.

As to the cost of maintenance of electric locomotives: The difference in the cost of maintenance at the rate of 3.5 cents a mile and 7 cents a mile is approximately $1,000 per engine per year. This saving, capitalized, represents a considerable sum, and would warrant an appreciable increase in first cost. The sum mentioned is 10 per cent of $10,000, or 5 per cent of $20,000.

With half a dozen different designs of electric locomotives, no one has had the advantage of experience with more than one of these types. Therefore, one's conclusions as to other types are based on opinions and theoretical considerations rather than actual results as shown by service records.

The New York Central electric locomotives are all equipped with bipolar, gearless motors mounted directly on the driving axle. The operating results have been completely satisfactory to the officers of every operating department affected. This statement, you will note, does not include the net financial returns from the investment, which must take into account the item of fixed charges.

With the usual maintenance these locomotives ride satisfactorily, do not have any undue effect on the track structure, and are perceptibly more comfortable than steam locomotives. In order to secure these results it is necessary to keep the total lateral motion, both in the boxes and center-pins, within limits which approximate three-quarters of the allowable lateral motion on steam locomotives.

Table I contains statistics which will permit a conclusion as to the reliability of these locomotives in service, and which will probably be more satisfactory than any general statement or expression of opinion, no matter how authoritative.

TABLE I.

TRAIN DETENTIONS DUE TO DEFECTS IN ELECTRIC LOCOMOTIVES

Year	Miles Per Detention—All Locomotives: Mechanical	Electrical	Grand Total
1912	48,271	103,967	32,965
1913	27,873	86,716	21,093
1914	35,625	57,395	21,981
1915	53,720	107,440	35,813
Type "S" Locomotives (Rigid Frame)			
1915	59,583	187,260	45,201

Note: All detentions of two minutes or more included. In 1913 and 1914 there was a total of 16 Class "T" locomotives placed in service. In 1912 there were 47 locomotives in service. Since the middle of 1914 there have been 63. Detentions due to man failures, or delays to following trains, not included.

In this connection I wish to enter a strong plea for the use of "miles per detention," instead of "miles per minute detention," as the unit in the preparation of statistics by which to judge the reliability of equipment in the service and the efficiency of the organization responsible for maintaining it. Including the time element leads only to confusion and is therefore, worse than useless.

TABLE II.

INSPECTION AND REPAIRS OF ELECTRIC LOCOMOTIVES

Year	Cost, Cents Per Mile: Labor	Material	Total
1912	1.888	1.460	3.348
1913	1.982	1.454	3.436
1914	2.155	2.134	4.289
1915	1.901	1.379	3.280

Note: The above statistics were compiled in accordance with the requirements of the Interstate Commerce Commission. In the year 1914 it was necessary to replace all driving wheel tires because of unsuitable material, regardless of the extent to which they had been worn. The costs of maintenance have been essentially as above since 1907, omitting 1914.

In studying Table II, the following facts should be borne in mind. These figures include the cost of inspection and

maintenance of all the electric locomotives, both road and switch. In 1912 and 1913 approximately half the total engine mileage and in 1914 and 1915 approximately one-third was that of engines used in switching service. Our experience has shown the cost of maintenance of engines in switching service to be about twice that of those used exclusively in road service. It follows that the cost of maintaining the road locomotives has been about 2.5 cents per mile and that of the switch engines about 4.8 cents per mile. In this connection it is only fair to call attention to the fact that these engines were not designed for switching service. Bearing this in mind, it will be seen they have given remarkable results.

For the first ten months of 1916 the average cost of maintenance of all the electric locomotives has been 2.73 cents per mile. This gives a cost of approximately 4 cents per mile for the locomotives in switching service and approximately 2 cents per mile for those in road service. I expect these costs will not be exceeded for the entire year 1916, but very much doubt that we will be able permanently to keep the maintenance costs at this level.

C. E. Eveleth (Baldwin Locomotive Works)—When an occasion arises to examine critically different designs of electric locomotives there is almost always a tendency, due to the individual's interest in specific features, to concentrate on particular elements and rather superficially consider the locomotive as a whole, but in Mr. Batchelder's paper we are fortunate in having a clearly brought out presentation of all the essential elements. A number of the elements are intimately related to common features of design, particularly the subject of "service time factor" and "reliability in service" of locomotives which are all affected directly by the simplicity of parts.

Disregarding other features, the bipolar type of locomotive with its freedom from all gears, pinions, gear cases and motor armatures and motor axle bearings has, as regards these three related subjects, a decided initial advantage over all other designs. It also has an unquestioned superiority in mechanical efficiency as shown by the table:

Relative Mechanical Efficiencies

Motor Design or Connection to Axle	Mechanical Efficiency
Bipolar gearless	100 Per Cent
Quill drive	99 " "
Geared drive (twin gears)	95 " "
Geared to jack shaft and side rods	90 " "
Direct connected jack shaft and side rods	87 " "

The difference in power consumption, due simply to the difference in the mechanical efficiency, may, when capitalized, amount to from one-third to one-half the original cost of the locomotives; in other words, to obtain the same overall economic result a material increase in investment in an engine of higher mechanical efficiency is justified, if such investment is necessary to obtain this type of drive.

In conclusion, it appears that considered from the mechanical design standpoint, Mr. Batchelder's claim for superiority of the bipolar gearless design for high speed service is founded on the incontrovertible facts that this type of engine is safe in operation, superior as to reliability and availability for service requiring no overhaul periods and requiring minimum inspection time, it has the lowest cost of maintenance on account of the elimination of gears, gear case, jack shaft, pin and motor bearings, and its maximum mechanical efficiency insures minimum power consumption.

With Mr. Batchelder's suggestion of the use of a truck center pin located in a well elevated position, all of the advantages of high center of gravity, so far as effect on rail displacement is concerned, can be obtained. On the other hand, with ordinary leading truck designs, it appears that the high center of gravity designs will give a low center of gravity effect by the action of the rear truck on the track unless the high center pin arrangement suggested by Mr. Batchelder is adopted on the trucks. These remarks, of course, refer to a symmetrically designed locomotive intended to run in both directions.

These features do not seem to have had general recognition, as they should place the bipolar gearless locomotive distinctly in a class by itself, and superior on account of these features to every other design. It is, therefore, to be expected that where the system of electrification will lend itself to the use of this type of locomotive, its application will become very general.

E. B. Katte, chief engineer electric traction, New York Central, stated that the riding of the New York Central electric locomotives had been materially improved by the addition of coil springs immediately over the journals. Before these springs were added, it was possible at high speed to follow the motion of the equalizers with the eye, it was so slow; in the event of any upward movement of the journals, the springs now have the effect of immediately forcing them down, before the effect of the movement is transmitted to the body of the locomotive.

George L. Fowler disagreed with the statement made by the author, in the section of his paper referring to safety of operation, that the rear driver puts a lateral pressure on the rail in excess of that produced by the other wheels, stating that in his experiments to determine the effect of lateral pressure on the rail, he had found that the front wheels invariably gave the highest thrust.

PEAT POWDER AS A LOCOMOTIVE FUEL

The Engineering, London, recently published an account of tests made on the Swedish State Railways with peat powder as a fuel for locomotives in comparison with British coal, in which it was shown that greater efficiency can be obtained by the use of powdered peat. The peat had a heat value of 7,740 B.t.u.'s and the British coal of 12,600 B.t.u.'s, and it was found that 1.45 lb. of peat powder will produce the same quantity of steam as 1 lb. of the British coal. The peat powder was blown through a nozzle into the firebox by compressed air from a steam blower. The firebox was subdivided into an ignition chamber, two side passages and an upper chamber through which the products of combustion are led to and fro before they enter the tubes. Under the nozzle through which the peat is blown, a small grate carrying a coal fire is provided for igniting the peat. The consumption of the coal for this purpose averages 3 to 4 per cent of the weight of the peat powder used. Firebox temperatures of 3,040 deg. F. were obtained with the peat powder, and 2,750 deg. F. with the British coal. A greater degree of superheat was obtained with the peat powder and the smoke box temperatures were generally less. The tests were made over a 60-mile division with a load of approximately 785 British tons. The engines used in the test were of the same type, having 19⅝ by 25-in. cylinders, 54-in. driving wheels, and 170-lb. steam pressure. It was calculated that the efficiency of the boiler was 73 per cent with the peat-fired engine and about 65 per cent for the coal-fired engine. The following is the analysis of the two fuels used:

	Peat	Coal
Carbon	47.0	73.5
Oxygen	29.5	4.4
Hydrogen	4.5	8.6
Sulphur	0.5	1.5
Nitrogen	1.1	1.2
Ashes	3.2	6.2
Water	14.2	4.6

How to Tell Malleable Iron.—If the break is clean malleable iron will show two distinct colors, white in the center and black on the outside, this black ring extending into the casting from 1/16 to ¼ inch. Malleable will spark a little but enough to show it is not cast iron, which does not spark at all.—*The Welding Enginneer.*

Car Department

ANTI-FRICTION BEARINGS A REMEDY

BY WALTER R. BYLUND
Hyatt Roller Bearing Company, Newark, N. J.

No one who follows the trade papers and technical institute discussions can fail to perceive that the anti-friction bearing is receiving a marked amount of attention. The automobile would not be a practical device if it were not for the anti-friction bearing. We are beginning to realize that other kinds of machinery and vehicles are not efficient without the anti-friction bearings. Therefore, why not use the anti-friction bearings as a medium for eliminating hot box trouble on railway cars?

In the first place wheels were put on a car to eliminate sliding friction. That is to say, rolling friction was substituted for sliding friction. But in doing this only a part of the sliding friction is eliminated because it still takes place between the journal and its bearing. Why not go a step further and substitute rolling friction for sliding friction there also?

I am familiar with the Hyatt flexible roller bearing.

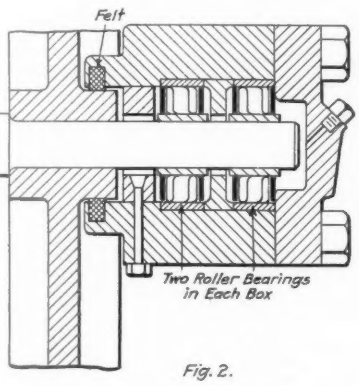


Fig. 2.

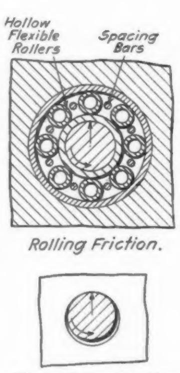


Fig. 1-Sliding Friction.

Therefore, in this discussion I shall consider this type. The pressure on a bearing is distributed over a narrow strip. That is to say the axle is a free fit in the box and pressure comes on only a part of it. The pressure is not distributed over the whole horizontal projection of the box. Fig. 1 illustrates this point.

When the resultant pressure is large the lubricant is squeezed out easily and in consequence heat is developed faster than it can be dissipated, which causes evaporation of the lubricant. This is one reason for hot boxes. Another cause is the fact that dirt gets into the box and breaks the oil film between the axle and the bearing.

The anti-friction bearings reduce friction, thus reaching the root of the hot box evil. As the friction is reduced the drawbar pull becomes less. P. B. Liebermann, engineer of tests of the Hyatt Roller Bearing Company, Newark, N. J., has run several dynamometer car tests to determine the drawbar pull of mine cars with plain and Hyatt bearings. The saving in drawbar pull in favor of Hyatt bearings was about 50 per cent at a running speed of about 5½ miles per hour. The starting pull of plain bearing cars was 150 per cent higher than Hyatt bearing cars. These tests were made at the Greensburg Coal Co., Greensburg, Pa. The results were published in the June Bulletin of the American Institute of Mining Engineers.

Of course, freight cars and mine cars are two distinct propositions. However, from these mine car dynamometer tests comparative results are afforded. When an anti-friction bearing equipped car runs at high speed, the saving of drawbar pull is not much over the plain bearing car. The great saving on high speed cars occurs at the time of starting.

Anti-friction bearings save lubricant. This is an important item because the amount of oil and grease that is wasted with plain bearings is enormous. On freight cars the pressure on the bearings is high and the lubricant is squeezed out. On mine cars where the pressure is not so great, Mr. Liebermann found that 80 per cent saving was made when Hyatt bearings were used.

PASSENGER CAR WORK*

BY J. R. SCHRADER
New York Central

Light Repair Work at Passenger Terminals and Yards.—It is important that minor defects which develop in the course of ordinary service be remedied promptly, as it is just such defects that, unless properly cared for, tend to create other defects of a more serious nature that necessitate the premature shopping of equipment and the expense incident thereto. Some definite system should be adopted to handle the various classes of defects which develop during the trips from one terminal to another. Material should be located at a central point so as to be easily accessible when required for emergency use in repairing cars made up in trains, etc. The conditions existing at various points would, of course, have to govern the organization of such a system, as at some terminals the work is performed on a piecework basis while at others the men are paid on a straight hour basis.

Some of the defects which should be carefully watched for are loose pedestal bolts, loose pedestal tie bar bolts, loose front carry iron bolts, defective brake beam safety hangers and defective brake beam release springs. Another important feature is the maintaining of cotter keys in brake connections, brake beam hangers, spring plank hangers, etc. Wherever possible all brake beam hanger pins, or other pins where a cotter is used, should be so applied that the cotter key is plainly visible when inspection is made.

Terminal or yard inspection, in particular, requires competent employees—men who have had considerable experience on car repair work and who are familiar with all the rules of inspection, which knowledge can only be obtained by previous experience. Great care should be exercised in selecting men for this work. Running gear inspection is the first inspection which a car must receive at a yard or terminal. Wheels, trucks, brake apparatus, etc., should be inspected closely to ascertain if they are in a fit condition for

*Presented at the convention of the Chief Interchange Car Inspectors' and Car Foremen's Association, held in Indianapolis, Ind., October 3-5, 1916.

further service; if not, the defects, whatever they may be, should be repaired locally, if possible. Terminal test of air brakes prior to departure of trains is another matter of importance. The problem of journal lubrication is a special class of work which requires the constant attention of regular men employed and trained especially for it. The men doing this work must be reliable in order that each journal box will be given the proper attention. Although this class of work requires the utmost efficiency, it is impossible to attain it at all times, for the reason that on many roads it is the lowest paid work in the inspection and repair force; consequently the men are continually changing.

Passenger Car Cleaning at Terminals.—Car cleaning at terminals is also an important problem, and a regular car cleaning force should be so organized that this work can be handled in a systematic manner. All passenger cars should be thoroughly cleaned inside and out. Railroads are especially liable to criticism in connection with car cleaning, as the condition of the cars is something with which the traveling public comes in direct contact. Exterior cleaning should be handled as follows: In wet weather the outside of the cars should be washed down with clean water and a brush on a pole of sufficient length to reach to the letter-board of the car. In dry weather the cars should be wiped down with waste slightly saturated with some kind of a cleaning oil. The windows should be cleaned with pulverized pumice and wiped off with a cloth to polish the glass. Close attention should be paid to the corners and to the edges of glass next to the beading to see that the glass does not become grimy. A piece of cloth wrapped around a small stick should be used to get into the corners.

The interior of the cars should be dusted down with a duster and swept with a toy broom. This broom should be spread out fan-shape so that the sweeper can get under steam pipes and in the corners where dirt becomes lodged. Also a small hook should be used to clean under the pipes. After car is swept between the seats and under the pipes with a toy broom, the floor should be swept with a hair floor broom. The interior of car should then be wiped with a cloth. Raw silk can be used to good advantage for this purpose. Mopping of cars should receive close attention. A pail of water with some kind of a disinfectant that will clean as well as disinfect should be used. A toy broom should be used in washing off the steam pipes, foot rests, seat pedestals and for scrubbing the floor, after which the floor should be mopped twice with a clean mop. The seat arms, window sills, leather seats in the smokers and the hoppers in the toilet rooms should be sponged off with disinfectant.

On cars that have double sash windows both sash should be raised and dusted and the surface of glass between the windows should be cleaned by means of a cloth placed on a stick which can be shoved up between the sash. Raw silk, slightly damp, will be found to work to good advantage for this class of work. The outside of the window curtains should be dusted and wiped with waste slightly saturated with some kind of a cleaning oil. The lamps and lamp shades should be wiped with a damp cloth. All washstands should be thoroughly cleaned and the metal work polished. The carpet aisle strips should be taken out and thoroughly swept and blown with air as often as possible. The seat cushions should be cleaned by means of a vacuum cleaner. The vestibules should be wiped with waste slightly saturated with a cleaning oil. The drinking water tanks should be cleaned with live steam at least once in every three days and should be emptied and refilled every trip. The ice should be washed off to prevent the ice compartment becoming dirty.

General Cleaning.—When cars become very dirty so that they cannot be cleaned by ordinary methods they should be given a general cleaning. The exterior of the car should be scrubbed with bead brushes and some kind of a cleaning oil or paste, after which the car should be wiped thoroughly with cotton waste so that the surface is clean and free from oil. In cleaning the interior all seat backs and cushions should be taken out of the car and the car blown out with compressed air. It should then be washed with linseed oil soap, then thoroughly rinsed off with clean water and wiped with raw silk cloth. The steam pipes, seat castings and floor should be given a thorough scrubbing with old brooms and flushed out by means of a water hose and mopped dry. After the car has been washed, the cushions and seat backs should be replaced and cleaned with a vacuum cleaner so that all dust will be removed.

Economy in Material.—The issuing of material should be carefully watched. New material should not be issued until the old material has been entirely used, as it often happens that the help cleaning cars will try to get new material before the old has outlived its usefulness. When the cloths used for cleaning windows, etc., have outlived their usefulness on this class of work they should be washed and used for other purposes. The foremen in charge should keep a close check on the material, as well as on labor, to see that the cost of car cleaning is kept down to the lowest figure possible to maintain the cars in clean and sanitary condition.

EDUCATE THE MEN

BY GEORGE C. CHRISTY
General Foreman, Illinois Central, McComb, Miss.

Because of the general interchange of freight cars it is not possible for any one division or any one railroad entirely to correct the hot box trouble. Every terminal or division will have to educate the men who actually do the work to see that journal boxes are given more consideration than merely feeling the box lid as an evidence of the condition on the inside.

Precautions should be taken in turning the journals to make sure that they are true and are in a smooth condition. When the wheels are pressed on, the journals should be coated with grease or paint to prevent rusting; new as well as old journals should be carefully examined before applying boxes. Make sure that the wedge has the proper bearing in the center, that the dustguard is of the right dimensions, that the brass has the proper bearing in the wedge and has a crown bearing on the journal as well as end clearance. One of the principal causes for hot boxes is that the brass has not been correctly tinned when being relined. Be sure that the men understand thoroughly how to do this work and the importance of having it done right. If the brasses are not properly cleaned before rebabbitting the babbitt will fall out within a short time, causing the journal to run hot.

In packing the box the waste should be formed in rolls so that there will be a long fibre to the packing in order that the oil may be fed from the cellar of the box to the journal. The packing must not be put in in a haphazard manner. It is not necessary to have it come in contact with the journal above the center line.

In my opinion, every car that goes to the repair track, whether empty or loaded, should have the journal box pulled and the brasses examined and put in proper condition before the car is returned to service. If this were done the hot box problem would be reduced remarkably, as all cars are placed on the repair track for some cause or other within the limit of the time it takes to wear out the journal brass.

In many cases trouble and delays could be avoided if the brakemen had a better conception of how to take care of hot boxes. Often when they notice a box running warm they get a bucket of water and a paddle, push all the packing jam up against the journal at the back and fill the box full of water, floating what little oil is left in the box out on the ground. The result is that the car is often set out, whereas if the packing had been stirred up intelligently and oil applied it would have run safely to the next terminal.

CAR INSPECTION OF VITAL IMPORTANCE*

Inspectors, Because of Added Duties and Responsibilities, Must Be Trained With Greater Care

BY HIRAM W. BELNAP

Chief of the Division of Safety, Interstate Commerce Commission

RAILWAY development of the past few years has vastly increased the importance of the car inspectors' work, and it is my observation that railway managers as a rule have not yet awakened to that fact, or, at least, have not sufficiently appreciated the change in the car inspector's status by making adequate provision to insure the proper performance of his increased and responsible duties. The car inspector's duties are so many and of such grave importance that but few employees in railroad service are called upon to exercise a broader general knowledge of the conditions of safe railroad operation than the man who inspects cars. With the tremendously increased size and capacity of cars, as well as length and tonnage of trains, it is necessary for car inspectors to be better qualified and better informed than the foreman used to be. A car inspector must be thoroughly familiar with the details of construction and maintenance of cars of all classes; he must understand the application of the rules of interchange, which are growing more and more complicated each year; he must know the federal safety appliance requirements in detail, including the air brake system. He must know the rules and regulations governing the loading, placarding, and handling of explosives and inflammable materials, and must be familiar with the requirements governing car clearance on every portion of the road on which he is employed; he must also be able to pass intelligently upon the loading of long materials. *In short, the importance of the car inspector's work has increased to such an extent that the service requirements can only be met by men above the average, both mentally and physically.*

Under present requirements a competent car inspector must be a man of alert mind and more than average intelligence. He must be prompt to act in emergencies, and both able and willing to assume responsibility when the occasion demands. The service is exacting, and the mind must act quickly in order that the man may properly perform the work imposed upon him in the limited time at his disposal. When all is considered, it is astonishing that capable car inspectors are found to perform the multitudinous duties that are imposed upon them, particularly when it is understood that their compensation compares very unfavorably with that given to men of equal mental attainments in other branches of railroad employment.

RELATION OF THE CAR INSPECTOR TO SAFETY

An indication of the necessity for thorough and painstaking car inspection may be had by considering the large number of accidents, with their resulting loss of life and personal injuries, as well as damage to property, due to defective car equipment, as reported in the statistics of the Interstate Commerce Commission. Car inspectors also have it within their power to decrease the number of violations of the safety appliance laws and resulting fines imposed upon the railroads, as well as to effect a considerable reduction in the claims for loss and damage to freight.

During the ten year period 1907-1916 there were 72,122 derailments reported to the Interstate Commerce Commission, of which number 33,782, or 46.8 per cent, were charged to defective equipment. In the total number of derailments which occurred during this period there were 3,334 persons killed, 51,952 injured, and a property loss of $62,381,338 was suffered. This property loss includes only the damage to equipment and roadway, and cost of clearing wrecks. Of the above items, defective equipment was responsible for 14.9 per cent of the deaths, 16.3 per cent of the injuries, and 43.5 per cent of the whole amount of property loss suffered in derailments, the figures for defective equipment accidents being 497 deaths, 8,491 injuries, and $27,160,785 property loss. The derailments due to defective equipment increase steadily from year to year as compared with derailments due to other causes. In 1907 they were 42.7 per cent of the whole, and in 1916 the percentage was 51.5; the average for the ten year period was 46.8 per cent. A tabular exhibit of this increase by specific causes, condensed into five year periods for the sake of brevity, is as follows:

Derailments Due to—	1907-1911	1912-1916	Inc. Per cent
Defective wheels	5,196	5,453	01
Defective axles	1,757	2,166	23
Defective brake rigging	1,845	2,548	38
Defective draft gear	795	1,553	95
Defective side bearings	310	777	150
Defective arch bars	637	1,368	115
Defective rigid trucks	333	1,000	200
Defective power brake apparatus	705	1,584	125
Failure of couplers	723	1,080	49
Miscellaneous equipment defects	1,593	2,359	48
Total	13,894	19,888	43

The number of casualties increased in proportion to the increase in number of accidents, the ratio of casualties to accidents being approximately the same for each five year period. The casualties for the year 1916 total 523, the vast majority of which number affected railroad employees. From the humanitarian standpoint alone steps should be taken to diminish the number of accidents due to this cause, which so greatly increase the hazards of railway employment. The chief hope of a bettered condition in this respect lies largely in diligent and efficient car inspection.

CAR INSPECTION AND PROPERTY LOSS

Nor is the property loss a matter of small importance. The damage to equipment and roadway and cost of clearing wrecks caused by defective wheels increased from $5,020,617 for the period ending June 30, 1911, to $5,398,634 for the period ending June 30, 1916. Increases in the other items included under defective equipment are as follows: Axles, from $1,314,337 to $1,852,631; brake rigging, from $1,408,962 to $1,812,025; draft gear, from $426,658 to $940,732; side bearings, from $225,806 to $540,418; arch bars, from $600,089 to $1,540,091; rigid trucks, from $189,811 to $594,074; power brake apparatus, from $397,587 to $779,033; failed couplers, from $337,197 to $514,952; miscellaneous equipment defects, from $1,227,230 to $2,039,901.

For the year 1916 alone the damage to equipment and roadway and cost of clearing wrecks due to defective equipment, amounted to $3,420,200. If to this sum there is added the amount paid in claims allowed for damage to property and injuries to persons, the annual loss to the railroads chargeable to accidents due to failure of equipment is so enormous as to compel attention, and demand remedies that will reduce this great economic loss of life and property to an absolute minimum.

It may be said that the increases above noted are about commensurate with the increase in the number of units of equipment during the same period, and are no more than

*From a paper on "The Selection and Training of Car Inspectors," presented before the January 12 meeting of the Central Railway Club and copyrighted by that club.

might reasonably have been expected to occur. This would be true provided our starting point represented a minimum, but experience demonstrates that such is not the case. Fortunately, we are able to show that certain kinds of equipment defects to which special attention has been directed, have enormously decreased during this same period, and as a consequence the accidents due to their existence have decreased in like proportion. I refer to the appliances for the protection of trainmen formerly covered by the standards of the Master Car Builders Association, and now subject to regulation by federal statute.

SAFETY APPLIANCE INSPECTION

When the Interstate Commerce Commission first instituted its inspection service, the railroad car inspectors had not been educated to give special attention to those units of equipments included in the standards for the protection of trainmen, and their inspection was not as thorough as it should have been. The first year of the Commission's work of inspection for which we have a complete record is the year 1902. In that year the Commission's inspectors inspected 161,371 cars and found 42,718 cars, or 26.47 per cent of the number inspected defective with respect to the items to which their inspections were directed; that is, out of every 100 cars inspected about 27 were found defective. For the year 1916, out of 908,566 cars inspected, only 33,715, or 3.72 per cent, were defective. This notable decrease occurred notwithstanding the fact that, owing to an extension of the law in 1910, inspections now cover a great many appliances that were not included in the earlier inspections.

There can be no doubt that this great decrease has been brought about by the education and training of car inspectors. When the federal inspection service was inaugurated railroad car inspectors had but vague and indefinite notions of the law, and they had received no special instructions relative to inspection of appliances covered by the federal statute. In many cases they looked upon the government inspectors as enemies, and devoted more attention to attempts to evade the law than to measures for compliance with it.

A few years ago, under the direction of the secretary of the Interstate Commerce Commission, accompanied by another inspector, I made an inspection on one of the large eastern trunk lines. During this inspection we were accompanied by one of the mechanical officers of the company, with authority to request at each inspection point that all of the available car inspectors might be assembled, so that the safety appliance acts and their application might be discussed. At each inspection point from four to twenty car inspectors were assembled, and the fact that impressed itself more than any other upon my mind was that each of these employees seemed to be hungering for information concerning the safety appliance work. The men were taken to a train yard where all classes of cars were available, and every question that they asked concerning the appliances covered by the law was fully explained. In many instances the men frankly stated that it was the first time they had ever had the safety appliance requirements explained to them in an understandable way, and it was indelibly impressed upon my mind at that time that the thing most needed to bring about a thorough understanding regarding the law was a system of instruction concerning it, so that those charged with the maintenance of these safeguards might have full information, not only as to their number, location, dimensions and manner of application, but also as to their necessity.

Within the past 15 years the Interstate Commerce Commission has distributed hundreds of thousands of documents for the education of car inspectors on various phases of the law, and has carried on an educational campaign through its inspectors which has been productive of marked results. Car inspectors now understand that it is our purpose to co-operate with them in accomplishing the ends of the law, and practically all of them have a good working knowledge of the statutes and their duties under them.

PROSECUTIONS UNDER SAFETY APPLIANCE ACTS

In addition to the influence which our educational campaign has had, much good has been accomplished from the work of railroad managers in their efforts to reduce the number of prosecutions for violations of the law. This influence has induced them to pay special attention to the work of their car inspectors with relation to safety appliances. Inspectors have been impressed with the necessity of paying strict attention to the inspection and repair of safety appliance defects; some roads have appointed traveling inspectors, whose duty it is to instruct local inspectors with respect to compliance with the law, all of which has proved of considerable profit to the roads, and points the way to similar benefits in connection with general inspection. A brief statement of prosecutions under the safety appliance law may prove of interest.

Up to June 30, 1916, there had been prosecuted under the safety appliance acts 2,033 cases involving 6,544 violations of these acts and penalties collected, exclusive of costs, to the amount of $479,300. A tabulation of these cases recently made discloses the interesting fact that of the total number prosecuted, 3,038, or approximately half, were for inoperative and defective uncoupling mechanisms—defects readily discoverable by inspection. The defects constituting these cases for prosecution are all ones that could easily and inexpensively have been repaired, and cover such simple defects as broken or missing keepers, disconnected and kinked uncoupling chains, missing uncoupling levers, etc., showing that the most prolific cause of prosecution is from a source probably most easily remedied. Defective or missing handholds have been the next most frequent cause of prosecution, there having been 1,875 such cases, or about 30 per cent of the total number of violations, these again being defects easily discovered and remedied at a minimum cost. The 303 cases of link and pin couplers, 168 cases of broken or missing couplers and 160 cases of couplers either too high or too low were fruitful of additional great expense to the carriers in penalties paid, while the 273 cases in which trains were hauled without the percentage of air brakes required by law shows the necessity for more thorough inspection.

Care and diligence in supervising and training engine and train employees have assisted materially in bringing the volume of collisions on American railroads in the last decade from 8,026 in 1907, to 4,770 in 1916. During the same ten year period derailments (46.8 per cent of which were due to defective equipment) increased from 7,432 in 1907, to 7,904 in 1916, of which latter number 4,073, or more than 50 per cent, were due to defects of equipment. These statistics suggest that a similar record might be possible if the same care and diligence were exercised in the supervision and training of the men in the car inspection service.

More frequent, more careful, and more intelligent inspection would most certainly lead to the prevention of a great majority of equipment derailments. While it is true that inspection of cars and locomotives in a train at inspection points must, under modern conditions, be more or less superficial, yet the practiced eye and the trained ear of the expert inspector are enabled to detect defects which to the untrained and inexperienced are undiscoverable. The younger and more inexpert men should have work in the field with men of experience in detecting defects, supplemented with class-room work which should show by means of failed materials exactly where and how the various integral parts

fail and how these defects may be discovered in the train. In any event, the car inspector is practically the only person that you can depend upon for a reduction in accidents due to defective equipment.

SACRIFICING SAFETY FOR DESPATCH

An important influence which militates against proper inspection of cars, particularly at terminals and division points, is the hasty manner in which railroad work is usually performed. The desire to maintain train schedules and prevent terminal delay in the movement of cars is, of course, highly commendable. It cannot be denied that every effort should be made to keep cars moving, and prevent delays by all proper means. This effort is often carried to extremes, however, and results in the sacrifice of safety for despatch. In many instances, train schedules are so arranged that entirely too little time is allowed for thorough inspection of passenger trains at terminal and division points, and particularly for the repair of such defects as may be disclosed by inspection. The cars have to be inspected practically "on the run," the inspector working under constant fear that he may be criticized for holding the train past its schedule leaving time, or in excess of the dead time shown on the card. The situation is not improved by the station or trainmaster, whose main thought is to prevent delay to the train while it is under his jurisdiction, and who is inclined to impress this thought upon the car inspector with unnecessary emphasis. Under such conditions the tendency to make inspections in an entirely superficial manner, and to slight, or entirely neglect, work that should receive careful and painstaking attention, is altogether too common.

Our accident investigations have disclosed numerous cases of improper inspection, due to lack of sufficient terminal time, as well as instances in which important high-speed passenger trains have been permitted to go forward with cars in defective condition. In several cases trains have gone forward without the required percentage of air brakes in operative condition. Investigation developed the fact that the inspectors had never been given definite instructions relative to the number of cars with brakes cut out to be run in a passenger train, the practice being to cut out the brakes if replacing the brake shoe would result in considerable delay.

RAILROADS SHOULD INSTRUCT INSPECTORS

A number of railroads have published instruction books and examination questions for the benefit of car inspectors and repairmen, but I have seen none of such that refers to anything except the air brake. It goes without saying that car inspectors and repairmen should have a good working knowledge of the air brake, but it occurs to me that it is fully as important that they should be instructed and examined concerning the M. C. B. standards relating to car construction and equipment, rules of interchange, etc., as well as all requirements of the laws. That there is a demand for instruction in such matters is proved by the fact that private parties have found it profitable to undertake the publication of books purporting to give the federal requirements, such books as a rule being merely copies of government publications. Car inspectors should not be required to buy books of this sort from private parties. Such information should be given them freely by their employers, to the same extent that air brake information is freely furnished. To operate a railroad without a comprehensive set of rules and instructions for train and enginemen, and without subjecting these men to examinations to insure that the rules and instructions are understood is unthinkable. Why is it not fully as important to know that car inspectors are fully informed concerning their duties and are competent to perform them?

SELECTION AND TRAINING OF INSPECTORS

Many addresses have been given and a large number of papers published with reference to methods of selecting and training men for different branches of railroad employment, but the bulk of the literature on this broad and important subject deals principally with the selection and training of employees for promotion rather than with that phase of the question which concerns us most directly here, namely, the selection and training of car inspectors properly to inspect and repair cars. It is self-evident that the workman of today, instructed and trained in the proper performance of his duties, will furnish good material for a foreman or other officer later on, and if the men in the ranks are up to standard in training and proficiency the problem of securing available men for promotion will be very much simplified.

The selection of men for employment in different capacities is a question which can be and is theorized about almost without end, but a great deal of such theorizing is visionary, and at any rate as applied to the employment of car inspectors, is entirely impractical. If there were ten applicants for every job, some discrimination in the selection of the one man could be exercised, and a method of elimination could be adopted for weeding out those not suited to the work. But no doubt most of you would tell me that the number of inspectors required is so large that considerable difficulty is found in getting a sufficient number of capable men for this purpose, and this difficulty is not improved by the low salaries which are paid to these men.

It is essential that the selection of men for employment as car inspectors should be assigned to some officer who not only is well informed regarding the duties and requirements of that position, but also who has some particular qualification or ability of sizing up men. And it is my belief that car inspectors should be recruited from the ranks of the repairmen. The inspector should have at least a common school education; he must be able to write a repair card in a legible manner, as well as to make out clear and comprehensive reports, and in order that he may have the necessary knowledge of car construction, he must have served for a considerable period on the repair track or as an apprentice car carpenter.

SANTA FE HAS FREIGHT CAR APPRENTICES

A modern apprenticeship system for car department employees is just as desirable and essential as for the mechanical and other departments. It is reported that of the 974 apprentices on the Santa Fe on May 31, 1916, 148 were freight car apprentices and 25 were car builder and coach carpenter apprentices.

At a recent meeting of the New York Railroad Club, F. W. Thomas, supervisor of apprentices for the Atchison, Topeka & Santa Fe, presented a very interesting and instructive paper upon the subject of "Training Young Men for Positions of Responsibility," showing the splendid results obtained by that railroad through its apprenticeship system. After carefully reading this paper, to my mind two thoughts stand out prominently: first, the manner in which these apprentices are treated from the time they first enter the service until they are placed in positions of responsibility; and second, the close supervision that is at all times given them during their course of apprenticeship. If similar conditions of service and supervision were applied to the training of car inspectors, I feel certain that there would be not only a bettered condition of equipment upon our American railroads and a remarkable decrease in accidents, but instances of prosecution under the safety appliance laws would be eliminated.

The practice is far too common to employ men as car inspectors and then to give them no special instructions or training. They are put to work and expected to pick up what information they can concerning the duties required

of them from other car inspectors, not too well trained themselves. It is a safe venture that nine out of ten inefficient car inspectors fail to measure up to their jobs on account of either lack of interest or lack of proper instruction and training, rather than inability to do the work required. This brings us face to face with the proposition that a workman is to a great extent what his boss makes him, and that the immediate superior of the car inspector is largely responsible for either his efficiency or his incompetency.

TRAVELING CAR INSPECTORS

Some systematic method of instructing car inspectors regarding their duties, and educating them regarding the importance of their work, should be adopted. It may be feasible to assign the duty of instructing car inspectors to the foreman, although in some cases no doubt it will be found necessary to instruct the foremen themselves, and assign the duty of further instruction to other employees. Another plan which holds much promise is the employment of traveling car inspectors who instruct the men and from time to time check up the condition of equipment and methods employed in the different train yards. It cannot be doubted that the knowledge that a traveling car inspector is on the road and likely to drop into a yard at any time has a stimulating effect upon car inspectors and their foreman. It is believed that the employment of a sufficient number of such traveling car inspectors to permit of checking up conditions in yards frequently would be beneficial. One such traveling inspector recently stated that while he had noted a marked increase in the efficiency of the inspection force at a large terminal on his line, he recently made an inspection of car and safety appliance equipment on freight trains leaving that terminal and discovered two defects, both of which happened to be penalty defects.

In how many of our large railroad terminals do the foremen of car inspectors go over trains personally? It may be granted that usually the foremen are well informed regarding the standards and requirements for car equipment, but too often their entire time is taken up by other duties which confine them to their office, and the foreman may not be aware of defects getting by one or more of his car inspectors until complaints regarding defective equipment leaving his terminal or inspection point are brought to his attention. It has been suggested, in order to require a foreman to check up his men more closely and to know that they are properly performing the duties required of them, that periodical reports regarding each inspector on his force be submitted to the general foreman of car inspectors.

A point which will bear much consideration and emphasis is to make the job as interesting for the man as possible. Many car inspectors will be found who are letter perfect, for example, in the United States safety appliance standards, but how many car inspectors, or even foremen of car inspectors, know why four ladders are required on a box car or why grab-irons must be at least 16 in. long and have a clearance of not less than 2½ in., and the reason for their definite location? In any case, it is desirable for the man to display some enthusiasm for his work and to take pride in doing it well. He will not display any enthusiasm for his work unless he feels it, and the basis for any such enthusiasm must be first of all a certain respect for his position.

DIGNIFY THE JOB

We hear much in these days of the desirability of men feeling enthusiasm for their work, and displaying loyalty to their employers' interests. Enthusiasm and loyalty are the necessary pre-requisites of efficiency. Unless a man feels enough interest in his work to be enthusiastic about it, he will value his job only for its material advantage to himself, and his feeling of loyalty to the interest of his employer will usually be a minus quantity. To create this feeling of enthusiasm and loyalty in the car inspection service, the position of car inspector must be made worth while. It must be made a preferred job; one that men in the lower ranks will strive to attain, not alone for its material rewards, but also for the position and importance that goes with it. If men are made to feel that their work is considered important, worthy of consideration, valuable to their employer, they will naturally feel enthusiastic about it, and the men below will strive with might and main to attain the higher position. When an organization is permeated with that sort of enthusiasm the question of loyalty may well be permitted to take care of itself.

Several definite propositions may be suggested for building up a proper regard for the work. One of the most important of these is a written examination for all car inspectors upon their employment, and subsequent periodical examinations, similar to examinations for train service employees. The inspector should also be furnished with information regarding the cost of materials used, and should be impressed with the value and importance of his work to the company. It has been suggested that there is frequently too much criticism and fault-finding, without constructive suggestions, on the part of supervising officers. Active interest and encouragement from the men higher up are essential to that "team work," without which the highest standard of efficiency is unattainable.

I may here cite another incident from my personal experience, which illustrates in a striking manner one of the evils to which the car inspection service is subject: On one occasion, accompanied by a general foreman in charge of a terminal, an inspection was made of a train ready to leave that terminal, which had cars in it on which were found a number of penalty defects, and if the train had been permitted to go forward it would have meant prosecution in the federal courts. After the inspection was completed an inspector was called to the office and inquiry was made as to whether or not he had inspected the train in question, and when it was ascertained that he had done so, the general foreman called his attention to the six serious and dangerous defects which existed on the cars in the train, and then and there dismissed him from the service. The next day this inspector informed me that in the two years he had worked in that yard it was the first time he had ever seen the general foreman in the train yard, and that at no time had he ever received any instructions relative to the requirements of the safety appliance acts.

The government has written upon the statute books a number of laws intended to lessen the risk of railroad employment, as well as prevent accidents, but no law, no matter how rigidly enforced, can correct evils that are directly chargeable to the failure of employees properly to perform their duties.

No class of men as a rule have a keener appreciation of their responsibilities than railroad employees, and any failure in duty on their part is often a form of thoughtlessness in which the chief motive is haste, or due to the fact that a full and complete understanding of their work is lacking. This, I believe, is particularly true in the car inspection service. One of the most encouraging signs of the times, to my mind, is that the railroad managers and employees in every branch of service are co-operating, through safety committees, in a campaign of education in which all interested participate for the common good, and from which is certain to result an improvement both in safety conditions and personnel.

In all branches of service, but particularly in the car inspection service, the system of education must go farther. Each of the appliances required on cars in the way of safety appliances were fixed only after most careful thought, as well as a study of the years of experience of the carriers, as indicated by the requirements fixed by the Master Car

Builders' Association. Car inspectors should be trained and educated so that the underlying reasons for all safety appliances are fully understood and comprehended.

The prominence which is given the work of the car inspector in recent discussions of railroad operating problems, is evidence that his importance as a factor in safe and economical operation is coming to be appreciated at its true worth. At the recent convention of the Chief Interchange Car Inspectors' and Car Foremen's Association, in Indianapolis, the scope of the membership was broadened so as to include car inspectors, and for the first time the association took up the discussion of general questions relating to car department problems, instead of confining itself entirely to the M. C. B. rules of interchange. Representative railway officers addressed the convention, the burden of their remarks being the importance of the car department and the necessity of selecting good men to perform the work imposed upon it.

F. W. Brazier, superintendent of rolling stock of the New York Central Lines, pointed out very clearly how the number of derailments could be reduced by more careful inspection, and very truly stated to the convention that there was no subject which it could take up that would result in more good to the railroads than better maintenance of equipment. He presented figures to show that of 25,550 cases of derailment, 32.5 per cent were chargeable to equipment failures. To use the words of an observer at this convention, as reported in the *Railway Mechanical Engineer*, "Car inspectors and car foremen! Officers in the mechanical and operating departments have sometimes elbowed them aside as if they were not worthy of or capable of the bigger things in the mechanical department. Times have changed. With the more severe and exacting conditions it has become apparent that just as high, and possibly a higher degree of executive and technical ability is required to solve car department problems and handle the labor question as in the locomotive and operating departments."

CONCLUSIONS

This whole question is a complex problem, worthy of the most thoughtful consideration of those high in authority in railroad management. In the suggestions I make in this paper I therefore avoid anything but the most general reference to what field the instruction and training of car inspectors should cover. The points which I have attempted to cover may be briefly summarized as follows:

(1) Railway development has vastly increased the importance of the car inspector's work within recent years, and adequate provision must be made to insure the proper performance of his duties.

(2) Over 46 per cent of all derailments which occurred on the railroads of the United States during the ten year period 1907-1916 were due to defects in equipment, These derailments caused 14.9 per cent of the deaths, 16.3 per cent of the injuries, and 43.5 per cent of the property loss suffered in all derailments during this ten year period. Derailments due to equipment defects are steadily increasing from year to year, and the chief instrumentality which the railroads must depend upon to improve this condition is the car inspector.

(3) That education and training of car inspectors is effective in reducing the number of equipment defects is proved by the record of decrease in defects reported by federal inspectors. In 1902, the defective cars reported were 26.47 per cent of the whole number inspected, while in 1916 the percentage was but 3.72, notwithstanding that the inspection in 1916 covered a great many appliances that were not included in the earlier inspections. This notable decrease has been brought about by the campaign of education which the Interstate Commerce Commission has carried on through its inspectors, by the distribution of thousands of documents, and by the work of railway managers in their efforts to reduce the number of prosecutions for violation of the law.

(4) An important influence which militates against proper inspection is the haste with which such work is usually performed. In many cases train schedules are so arranged that entirely too little time is allowed for thorough inspection of passenger trains, and the inspector is working under constant fear that he will be criticized for holding the train past its schedule time. Under such conditions the tendency to make inspections in a superficial manner and to slight or neglect work that ought to be done, is altogether too common. Our accident investigations have disclosed cases of improper inspection, due to lack of terminal time, in which important high-speed trains have been permitted to go forward with defective brakes, and in some cases without the lawful percentage of brakes in operation. In these cases the inspectors have stated that they had never been instructed about cutting out brakes on passenger trains, and it was their custom to cut out brakes, if replacing worn out brake shoes could not be done in the time allowed.

(5) The selection of car inspectors should be assigned to some official who is well informed concerning the duties of the position and who has some ability in reading character. Generally speaking, inspectors should be recruited from the ranks of the repairmen. Before being placed at work in this responsible position, it should be thoroughly drilled into them that any omission to detect defective equipment is fraught with danger to life and limb. They should be efficiently instructed as to each standard of safety involved in the safe running of the car, and such standards should be formulated in rules as far as such formulation of fixed rules is practicable. An inspector should have at least a common school education; he must be able to write a repair card in a clear and legible manner, and make out clear and comprehensive reports. A modern apprenticeship system for car department employees is just as desirable as for the locomotive or other departments.

(6) It is believed that nine-tenths of the inefficient or incompetent car inspectors fail to measure up to their jobs, either through lack of interest or lack of instruction and training, rather than through inability to do the work required. To create the requisite interest and enthusiasm for the work the job must be made worth while. It should be made a preferred position, which men in the lower ranks will strive to attain, not alone for its material rewards, but also for the dignity and importance that goes with it.

(7) Definite propositions for inculcating proper regard for the work are: written examinations covering all matters, concerning which inspectors must be informed, such as Master Car Builders' standards, rules of interchange, federal requirements, rules for loading long materials, regulations for the loading and handling of explosives and inflammable materials, strength of materials, etc., periodical examinations leading to line of promotion, similar to examinations given train service employees; schools of instruction where men may be taught concerning their duties; proper supervision and adequate compensation.

DISCUSSION

F. W. Brazier (N. Y. C.) commented on the extravagance of departing from approved designs and specialties to save a few dollars in the first cost of cars and then spending many times more in maintenance to keep them in service. Railroad officers could save much trouble and expense if they would study government reports more closely, with a view to remedying the defects which cause the greatest trouble. It is a serious mistake to repair cars in kind if they get out of order shortly after the repairs are made. Wooden door stops were cited as a case in instance. Moreover, some roads, although the capacity of the cars and size of doors on box cars have been considerably increased, are using the same door fixtures as they did 15 years ago. It

is little wonder that trouble is experienced. On the New York Central extra compensation is paid to inspectors, and especially in passenger car work, for finding hidden or obscure defects that in the judgment of the foreman would not have been discovered in the course of ordinary inspection.

W. H. Sitterly (Gen. Car Inspector, Pennsylvania, Buffalo) thought that proper training of car inspectors is afforded by having foremen car inspectors who have the backing of the higher officers. Inspectors at interchange points should first serve in classification yards. One source of trouble is the issuing of orders to foremen car inspectors by officers who have never had experience in that work. The car inspector is receiving greater recognition today than in the past.

P. J. O'Dea (G. I., Erie) said that car inspectors had been much neglected and that there is immediate necessity for a broader and more liberal treatment of these men. Certain rules were drawn up for the government of car inspectors by the M. C. B. Association in 1902. Because of changed conditions these rules are obsolete, and yet they are printed in the proceedings from year to year, with no effort to make them effective. Car inspectors should receive a wage in keeping with men of similar skill and industry in other fields. The public demands better and safer service. It will be a good investment to take measures to insure a better and higher grade of inspectors. As important as monetary returns is the necessity of interest and backing from the higher officers. The value of traveling inspectors in checking the work and bringing up the standards has been demonstrated.

R. V. Wright (*Railway Mechanical Engineer*) advocated the necessity of giving more attention to the selection of freight car repairmen and of educating them not only to a better performance of their work, but with a view to future promotion to positions of greater responsibility. It is from these men that most of the car inspectors are selected, and there is no reason to believe that this practice will not continue. Attention was directed to the efforts being made by the Chief Interchange Inspectors' and Car Foremen's Association along these lines.

T. J. O'Donnell (Arbitrator, Niagara Frontier Car Inspection Association) thought that the expenditure of upwards of $100,000,000 by the railroads in the last 10 years in bettering the equipment was an indication of sincerity on their part in meeting the demands of the government and public opinion for better and safer service.

J. P. Carney (G. C. I., Mich. Cen.) emphasized the value of a bonus, or extra compensation for the discovery of hidden or obscure defects.

Henry Boutet (C. I. I., Cincinnati) stated that the car inspector was held responsible for inspecting the trains and should not allow them to depart until his work had been properly and thoroughly done. He suggested that Mr. Belnap arrange to have his men hold schools at various important points to instruct the railroad inspectors as to exactly what was required by the government.

CAR DEPARTMENT APPRENTICES*

BY W. K. CARR

Chief Car Inspector, Norfolk & Western, Roanoke, Va.

The car department apprentice is only a boy actuated by all the inclinations of youth; at the same time he is usually susceptible to reasoning and good training. It is not, as a rule, a difficult matter to care for a genius or a boy who has a natural bent for mechanics and is intensely interested in his selected work. But the handling of the average boy may be a problem, and a very serious responsibility. Many boys, even below the average in interest and natural aptitude for mechanics and car work, often make good men and reach positions of authority due to their cleverness as executives.

A boy's initial work in the general car department may largely depend upon his previous training. The boy that has had no training should first enter the passenger car frame or body shop. There he would be able to see the results of skill; at the same time the work should not be sufficiently wearing on him physically to dampen his interests and desires. In the passenger department he would better understand the relation of the various parts to each other, and in a general way see why the details are of certain sizes, etc. It is desirable to lead the boy along natural steps, allowing him to progress from one shop to another so that the opportunities offered will be in sequence, and the boy's advancing experience will have better prepared him to add to his accumulating knowledge.

The special advantages offered by promoting the boy from the passenger body works to the passenger car truck and platform gang would be on account of the latter embracing so many real problems of passenger car equipment, operation and maintenance that may not be so well appreciated if such work is taken up in advance of the acquirement of knowledge as to the general construction, names and functions of the various parts. If the apprentice will apply himself he will soon become trained to look for broken parts, excessive wear, lateral motion and other defects likely to develop in train service, some of which produce rough riding equipment; also those defects that may affect safety.

The apprentice should remain at least 12 months on body, truck and platform work. Opportunity for becoming familiar with the different lines of construction should be offered the apprentice to the fullest possible extent, and here is where the foreman can be of great assistance to the boy. In fact, much depends on the aid and encouragement offered by the foreman and associates. Of the two schedules given below, one contemplates three months on new freight car work and six months in the drawing room, where it can be offered. Both schedules also show how time may be otherwise distributed.

Departments	Months	Months
Passenger car body and truck shop	12	12
Freight car—new work	3	..
Freight car—truck	3	6
Freight car—repairs—wood (general)	6	6
Freight car—repairs—steel (general)	6	6
Air brake department	3	4
Freight—operating yard—inspecting and air brake pipe work	3	6
Passenger trimming shop	3	4
Drawing room	6	..
Passenger car body	3	4
Total	48	48

Beginning the second year, the apprentice should either go on freight car work of the various sorts, or drop into the freight car truck gang and be assigned to general truck work and steel cars. About six months can be well spent in such duties affording invaluable opportunities to secure experience in all freight car construction work, and it would also tend to harden or build up the apprentice physically for the freight car repair work, where he should next be directed for a period of about six months each on wood and steel car general repair work. The apprentice should then be in a receptive condition for three or four months in the air brake department. From there he should move to the freight operating yard, and be assigned to car inspection and also air brake pipe work for a period of about three months. Here he will have opportunity to see defects which result from service.

After the yard experience the apprentice should spend three or four months in the passenger trimming shop, and then enter the drawing room, always being noticed and encouraged by the foremen, finally finishing his time in the passenger car body shop.

*This article was awarded the third prize in the competition held by the Chief Interchange Car Inspectors' and Car Foremen's Association for the best article on Car Department Apprenticeship. The result was announced at the annual convention of the association, held at Indianapolis, Ind., October, 1916.

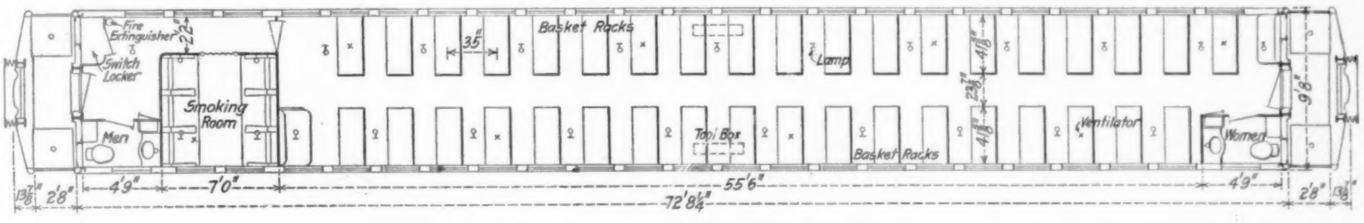
STEEL PASSENGER CARS FOR D. & H.

Two Designs of Coaches Differ Chiefly as to Seating Arrangement; Ventilated Baggage Cars

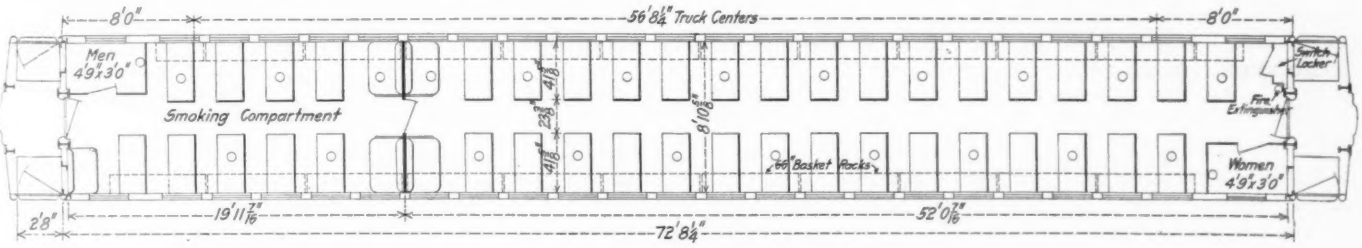
MANY noteworthy features of design are found in an order of cars for passenger train service, recently put in service by the Delaware & Hudson, which included nine coaches built by the Barney & Smith Car Company, and nine coaches and six baggage cars built by the American Car & Foundry Company. Data concerning these cars will be found in Table I, and a comparison of the cars with others of similar type in Table II.

The principal dimensions and nearly all the details of the coaches from the two builders are the same, but a change has been made in the seating arrangement, the cars built by the Barney & Smith Company having a smoking room accommodating six persons and seats in the main portion of the car for 78 passengers, while one end of the cars built by the American Car & Foundry Company is partitioned off to form a smoking compartment, the seating capacity of the smoking section being 24 and of the main compartment, 66 persons.

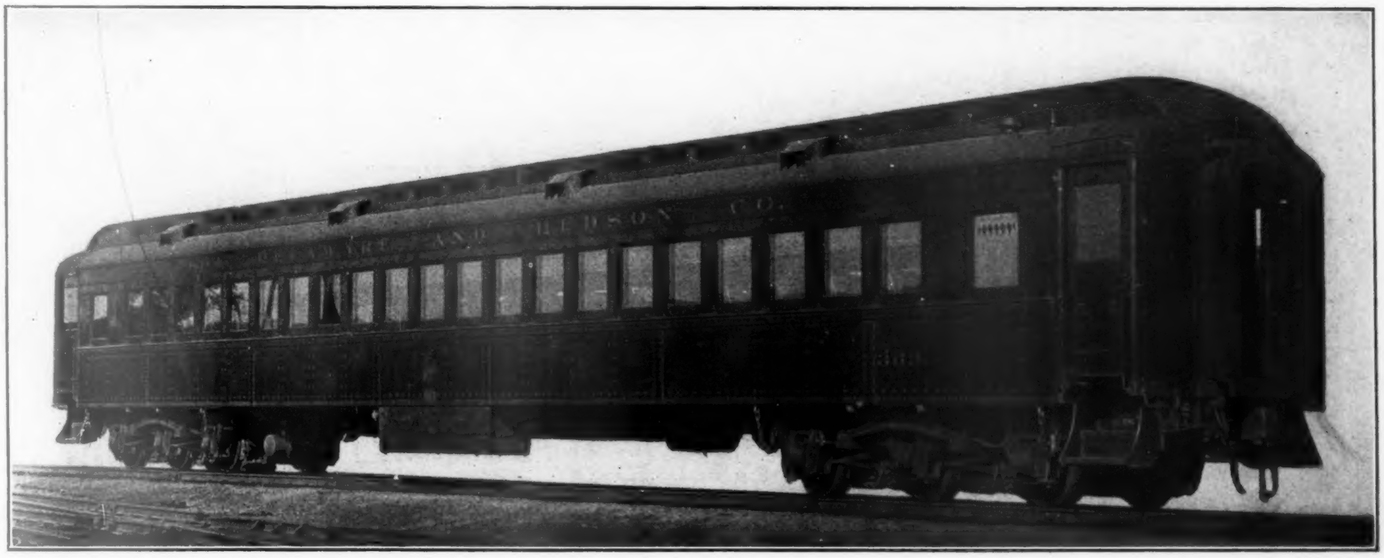
In the construction of the underframe, a combined cast steel platform and double body bolster is used. The double center sills are of the fishbelly type, 26 in. deep at the center, with 5/16-in. web plates, set 18 in. center to center. The cover plates are 7/16 in. by 30 in. with 3½-in. by 3½-in. by ½-in. angles riveted to the outside of the web plate at the top and to both inside and outside at the bottom. The crossbearers are built up of a cast steel section riveted to the web plates on either side, further secured by top plates 5 in. by ½ in. extending across the cover plates and under the angles which form the bottom of the center sills, to which the crossbearers on either side are riveted. The side sills are angles 6 in. by 4 in. by ⅜ in., riveted to the crossbearers and body bolsters, and the floor beams are 6-in. 8-lb. channels, riveted to ¼-in. pressed angle brackets on the web plates and side sills. In the cars built by the Barney & Smith Company, a false floor, made of 1/16-in. plate is secured directly to the floor beams and above this the wooden floor stringers are placed. The American Car & Foundry Company makes use



Floor Plan of D. & H. Coach with Smoking Room



Floor Plan of D. & H. Coach with Smoking Compartment



Steel Coach for the Delaware & Hudson

of 3-in. by 2½-in. by ¼-in. angles, fastened to brackets resting on the floor beams to furnish a support for the false floor at the level of the center sill cover plates. The longitudinal floor support between the body bolsters and the end

TABLE I.—WEIGHTS AND DIMENSIONS OF NEW CARS FOR THE DELAWARE & HUDSON

Cars	Total weight, lb.	Dead weight, lb. per passenger	Seating capacity: Coach	Seating capacity: Smoker	Length inside	Truck: Type	Truck: Journals
Coach	146,200	1,740	78	6	71 ft. 11⅞ in.	Six-wheel	5 in. by 9 in.
Coach	138,710	1,541	66	24	71 ft. 11⅞ in.	Six-wheel	5 in. by 9 in.
Baggage	110,440	.....	..	..	60 ft. 0 in.	Four-wheel	6 in. by 11 in.

TABLE II.—COMPARATIVE DATA ON STEEL COACHES.

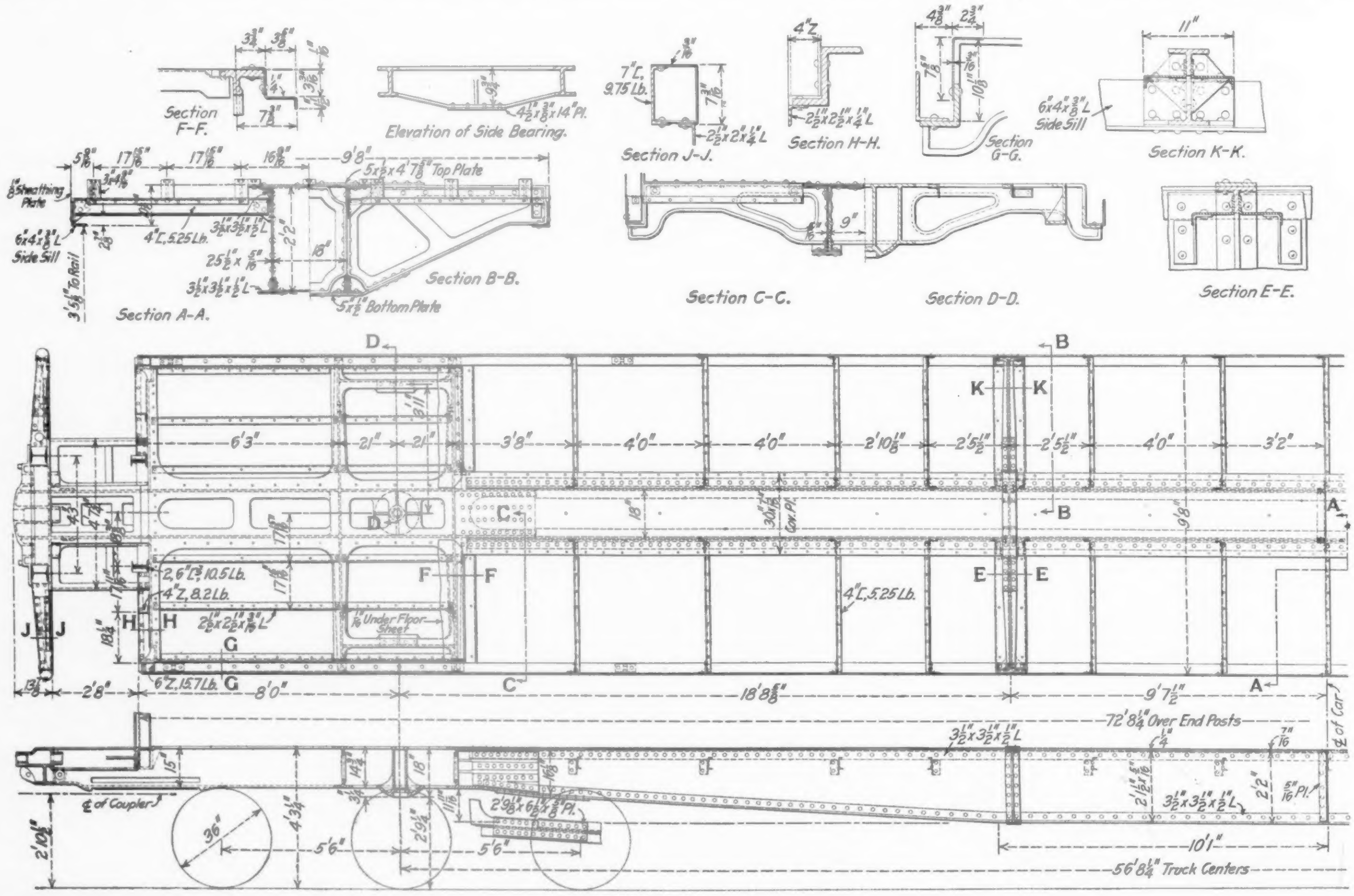
Railroad	Total weight, lb.	Seating capacity	Dead weight, lb. per passenger	Length over end sills	Type of truck
D. & H. Co.	146,200	84	1,740	72 ft. 8¼ in.	Six-wheel
D. & H. Co.	138,710	90	1,541	72 ft. 8¼ in.	Six-wheel
Boston & Maine	120,000	88	1,364	70 ft. 3½ in.	Four-wheel
Pennsylvania	120,000	88	1,364	70 ft.	Four-wheel
New Jersey Central	115,800	78	1,480	63 ft.	Four-wheel
New Haven	131,000	88	1,488	70 ft. 6 in.	Six-wheel
Can. Nor.	140,000	84	1,670	72 ft. 6 in.	Six-wheel
New York Central	142,000	84	1,690	70 ft.	Six-wheel

of the car is formed by 2½-in. by 2½-in. by 3/16 in. angles which are riveted to the flanges of the platform casting. The floor stringers are riveted to the false floor and supporting angles.

The side posts of the cars built by the Barney & Smith Company are of a flanged U-section, as shown in the drawings, while the American Car & Foundry Company employs two channel sections of pressed steel, with the flanges turned toward each other to form the posts. In both designs pressed sections are used to form the window casings. The end posts are built up of Z-bars and pressed steel shapes. A belt rail ½ in. by 4 in. extends the entire length of the car body, and a pressed steel belt rail stiffener extends between the side posts under the window stools. The side posts are fastened at the top to Z-bar side plates which carry the lower deck carlines, the latter being pressed steel, of channel section. Between each of the carlines is a 1½-in. by 1½-in. by 3/16 in.

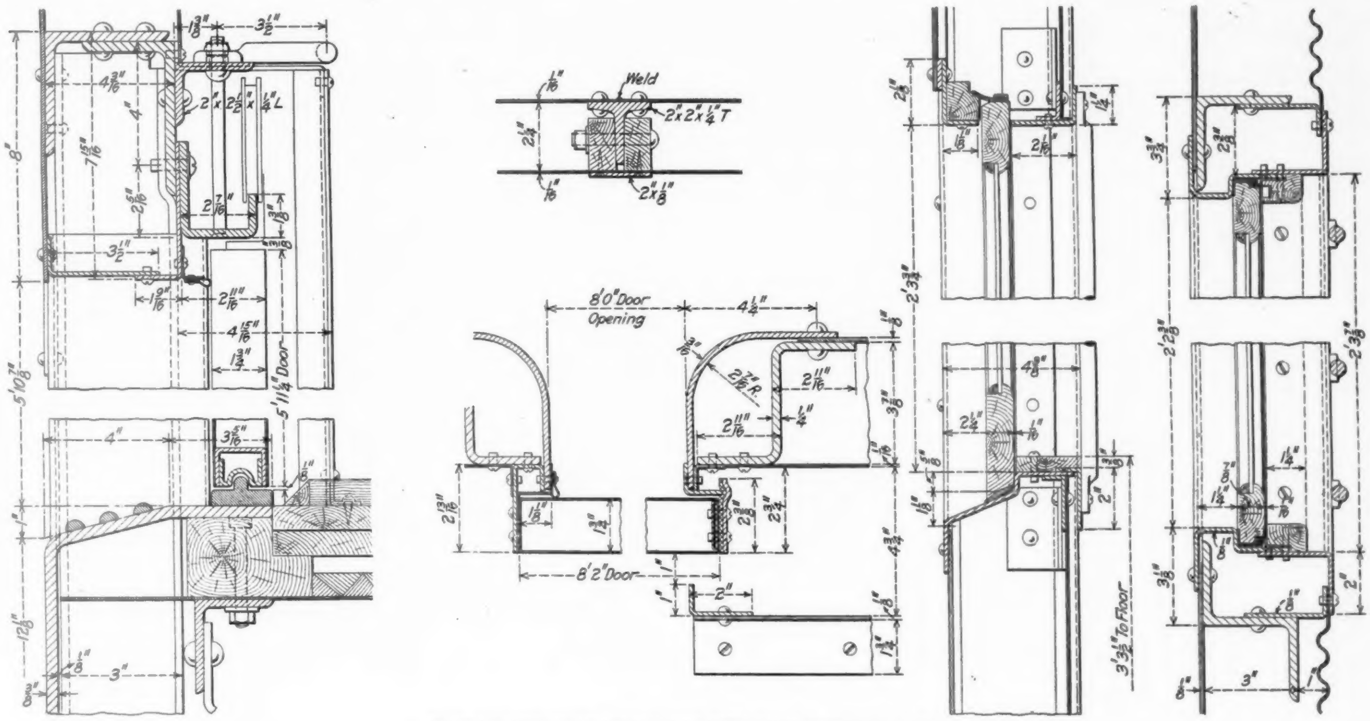
Interior of One of the Coaches Looking Toward the Pulman Smoker

angle which serves as an additional support for the lower deck roof. The inner ends of the lower deck carlines and roof supports are fastened to an angle iron which, with the carlines, supports the deck posts, which are similar in sec-

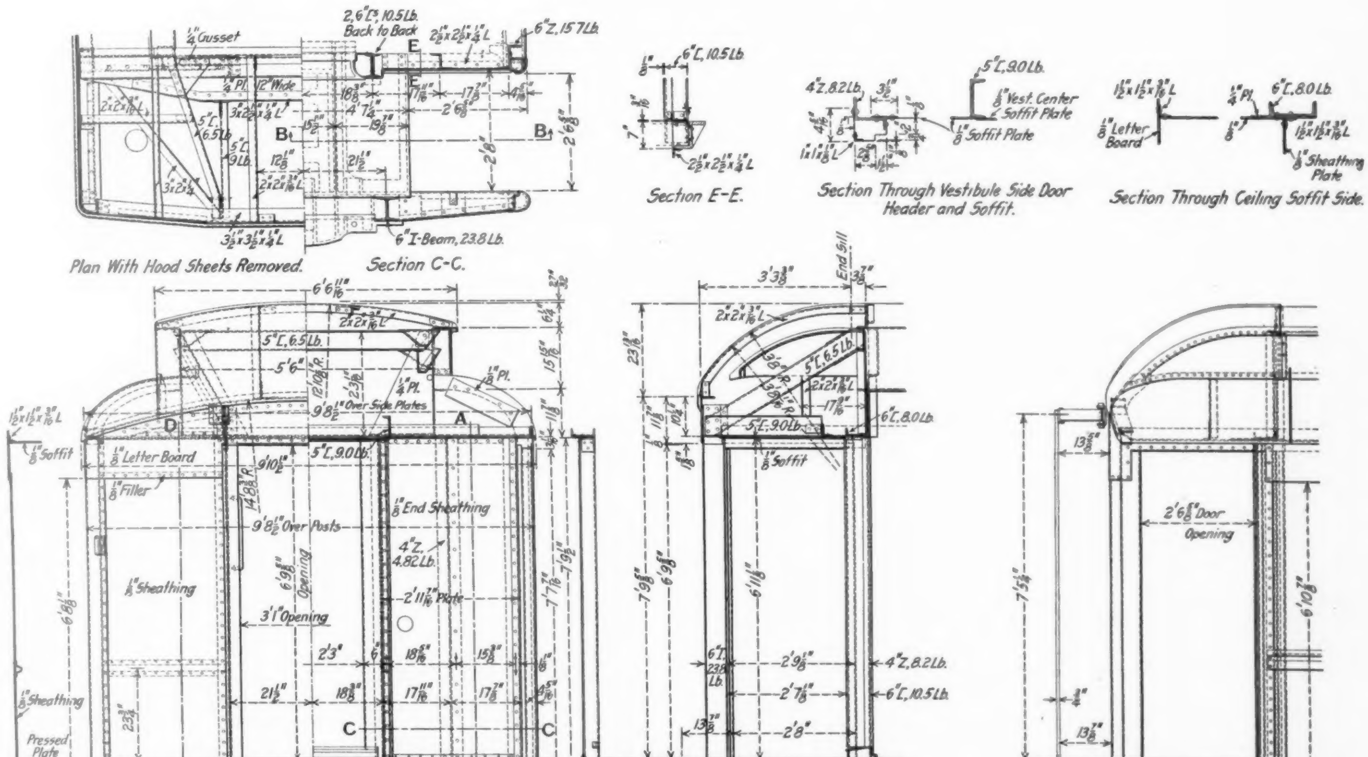


Underframe of the D. & H. Coaches

tion to the side posts. A pressed steel channel with unequal legs is riveted to the top of the deck posts and carries the upper deck carlines, in which the side post section is again nels, weighing 10.5 lb. per ft., riveted together through the webs. Between the corner posts and door posts is an intermediate post, for which a 4-in. 8.2-lb. Z-bar has been used.



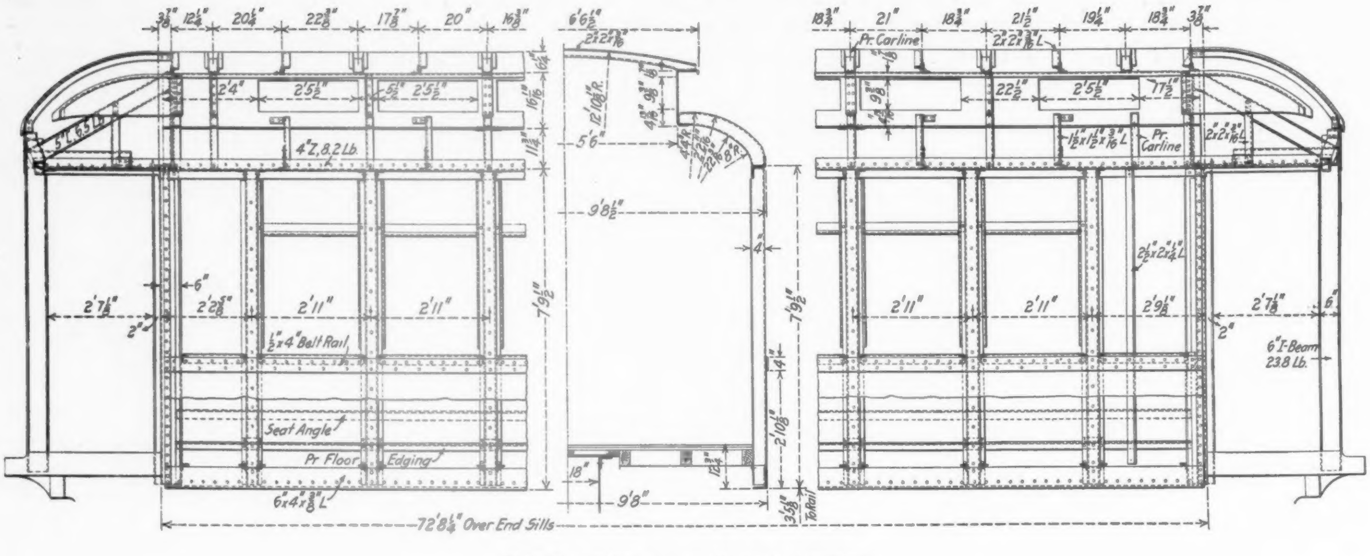
Sections Through Floor and Window of Baggage Car



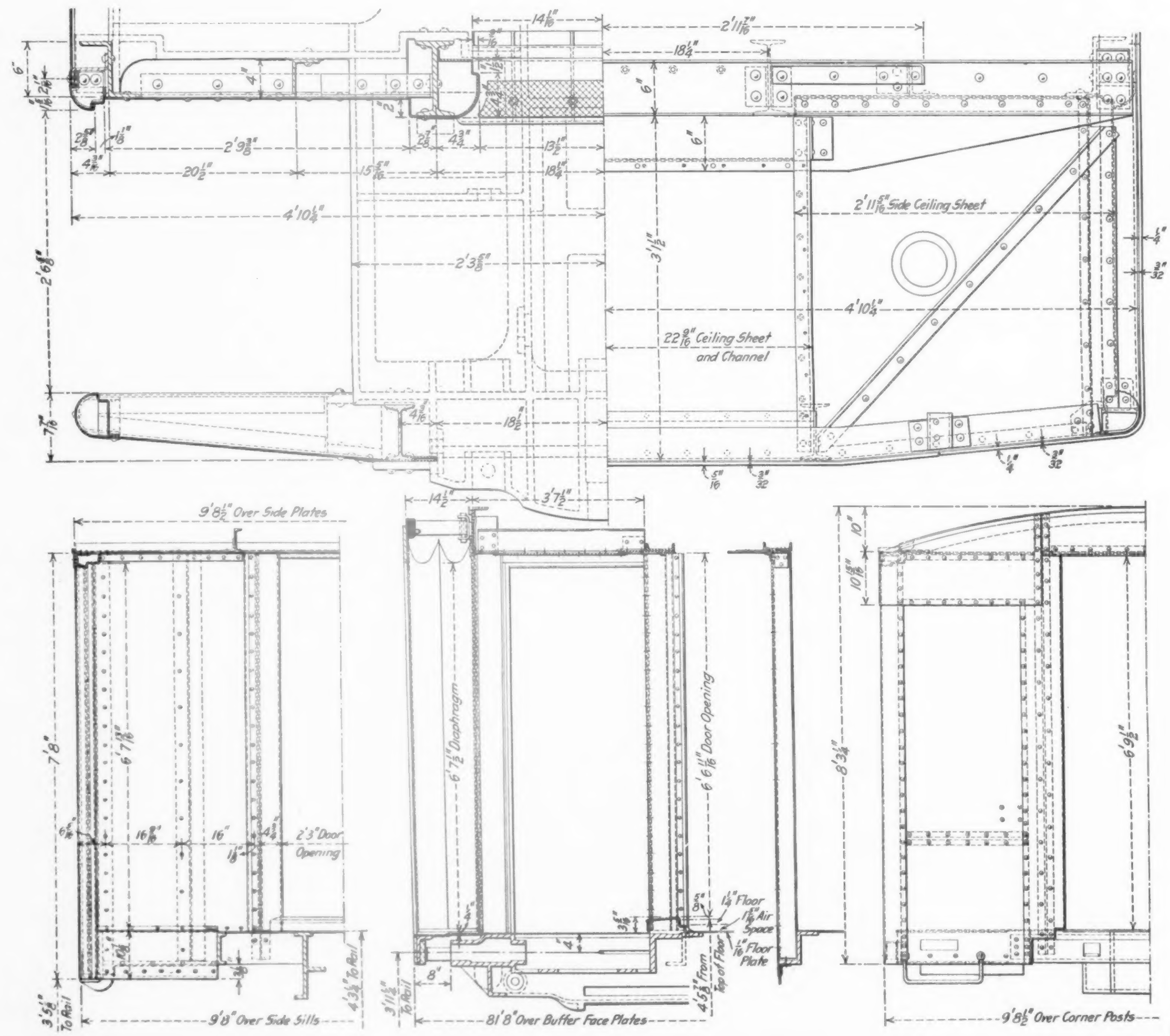
End Framing and Vestibule Details

repeated. Midway between the carlines are placed 2-in. by 2-in. by 3/16-in. angle iron roof supports.

In the framing at the end of the body, structural shapes are used, the corner posts being 6-in. Z-bars, weighing 15.7 lb. per ft., while each door post is formed of two 6-in. channels. The end posts and corner posts are fastened at the top to a 6-in. channel, to the inside flange of which the bulkhead plate is attached. A 5-in. channel extends between the end deck posts. The buffer beam is a built-up member, supported by the platform casting, the outside being formed of a 7-in.

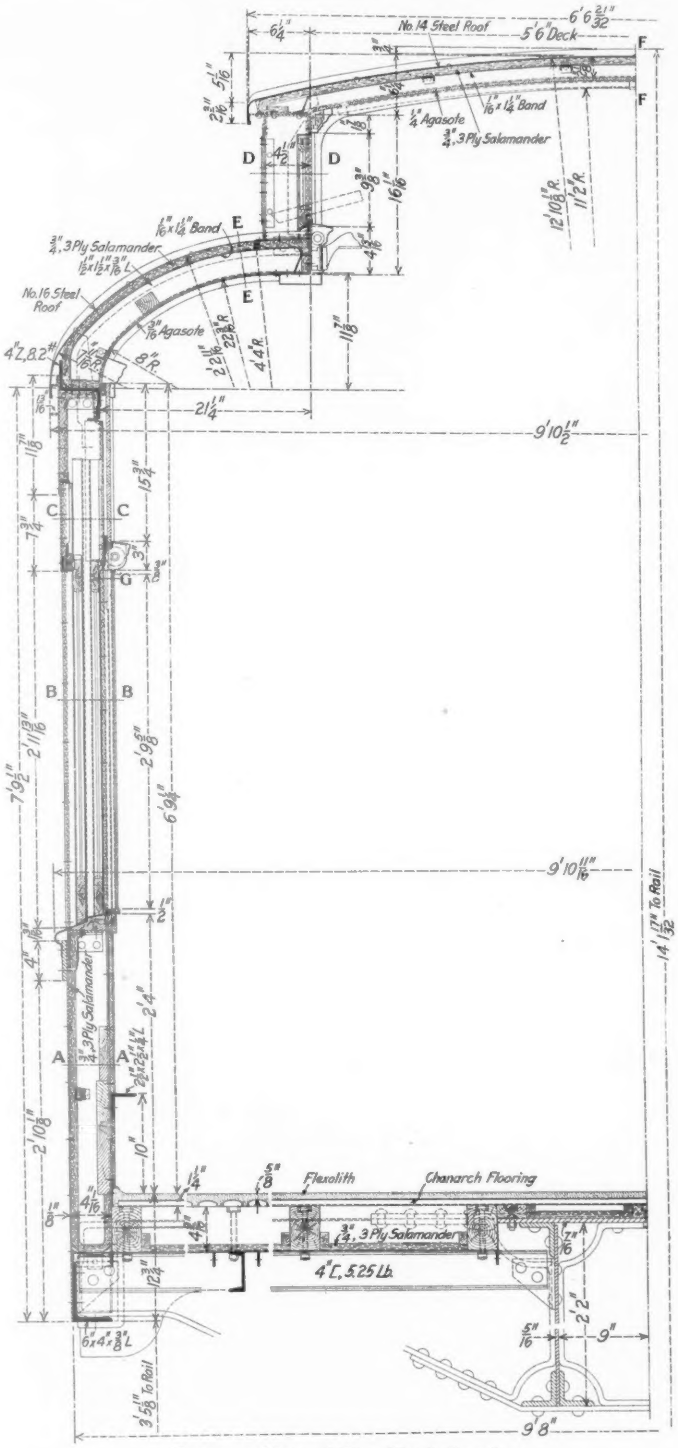


Side Framing of the D. & H. Coaches



Details of Vestibule of the D. & H. Coaches

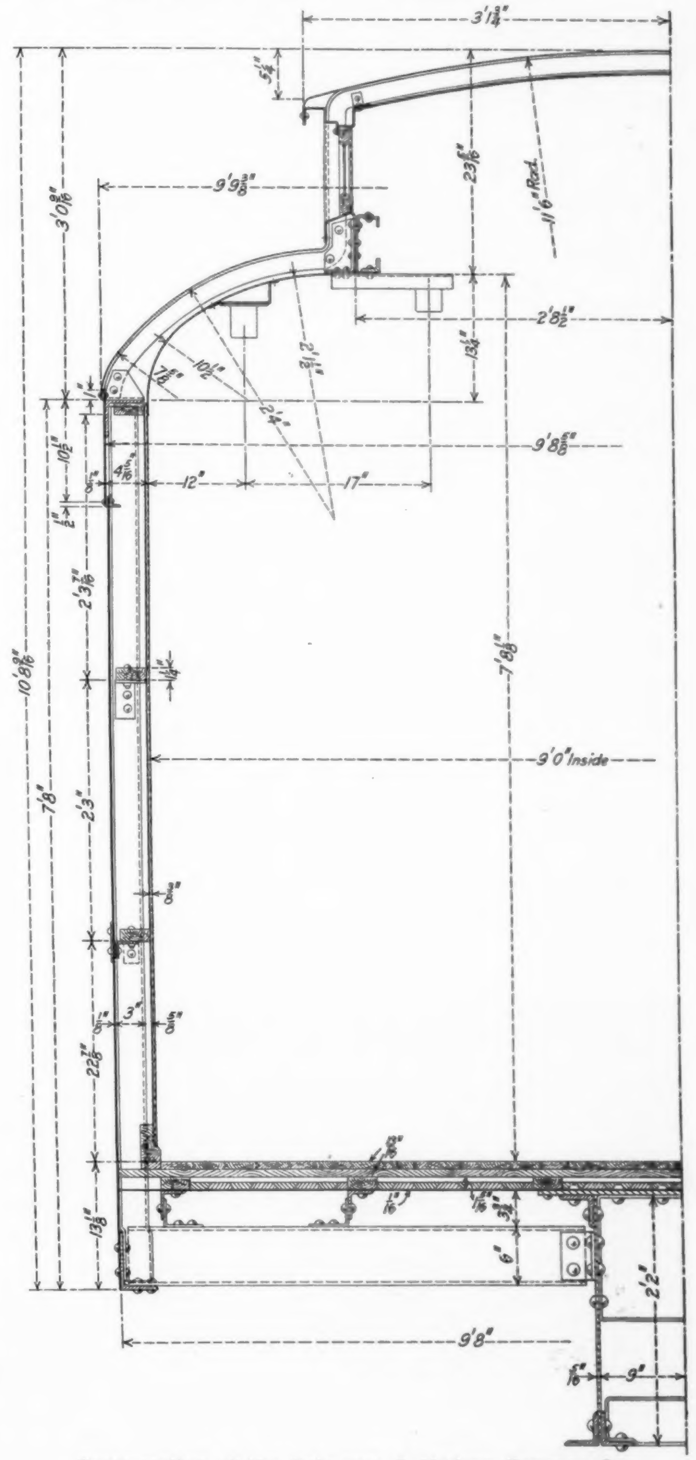
channel. The vestibule corner posts are Z-bars, while at each side of the end door opening, 6-in. I-beams of special section, weighing 23.8 lb. per ft. are used. To the upper end of each of these posts are fastened two channels of 5-in.



Cross-section of the Steel Coaches

sections, one connected to an angle iron riveted to a stiffening plate which extends across the body end posts, the other extending up to the deck plate. The posts and the side plate are joined by 3-in. by 2-in. angle irons; light angle irons support the vestibule ceiling and 2-in. angles form the framing for the end of the upper deck.

The side and end sheathing is ⅛-in. thick. The upper deck roof sheets are of No. 14 sheet steel and the lower deck roof of No. 16 sheet steel, both having welded joints. The insulation in 15 of the coaches is 3-ply ¾-in. Salamander, which is held in position by spring steel bands. In three of the coaches 3-ply Linofelt has been used. The flooring is of Flexolith cement, laid over Chanarch flooring, the color matching the lower sides of the coach. The interior of the coaches is finished in imitation of grained mahogany, with green Agasote headlining in nine coaches and gray Agasote in nine coaches. The seats, except in the Pullman smoking room, are the Walkover type, made by the Hale & Kilburn Company, covered with "Chase" plain green plush seat covering in the coach end, and Pantasote in the smoking compartment. The seats in the Pullman smoker are known as the English type, covered with Spanish leather.

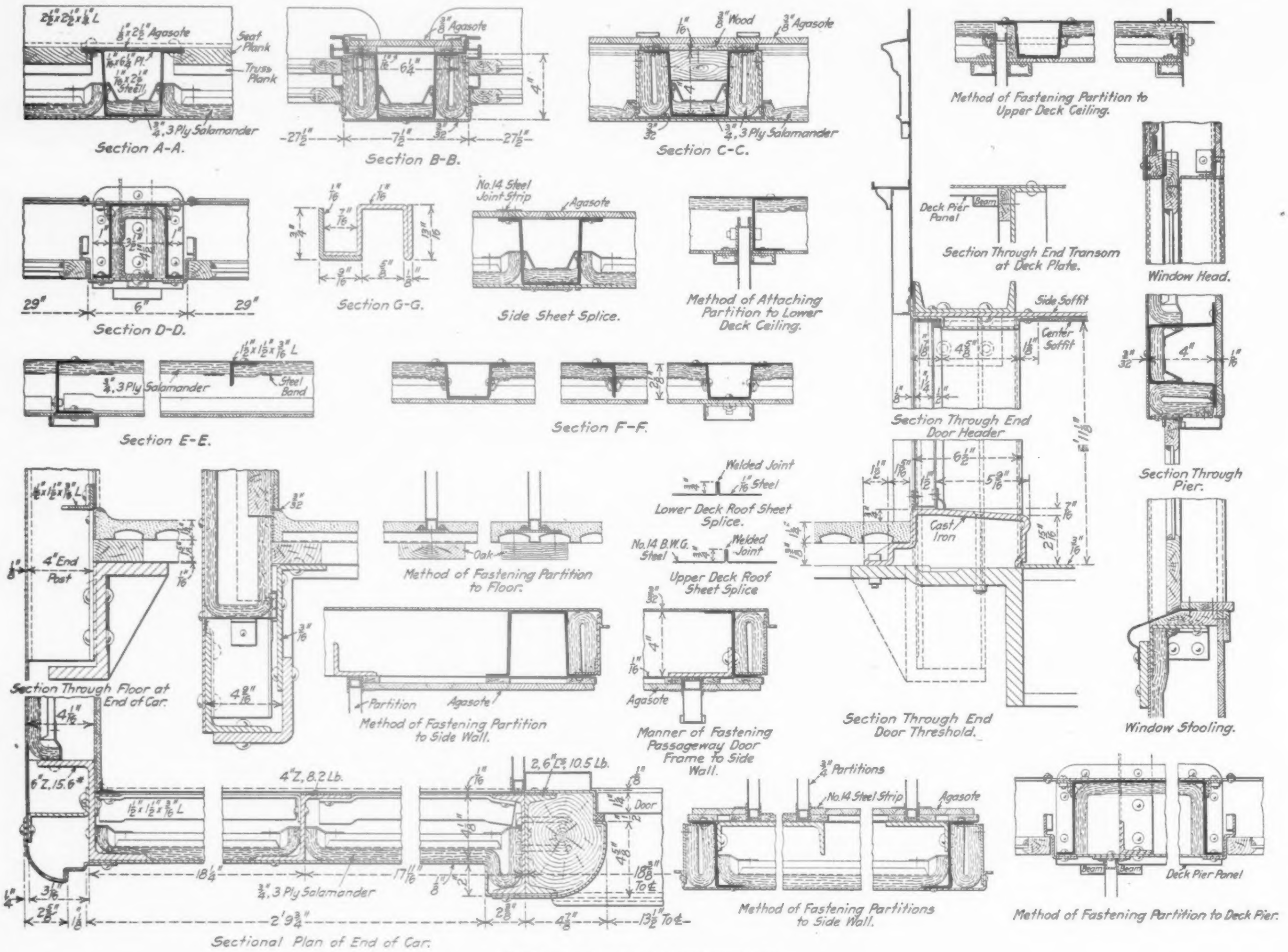


Cross-section of the Delaware & Hudson Baggage Car

The baggage cars are similar in general design to the coaches, except that Z-bars have been used for the side posts, instead of pressed steel shapes. The interior finish of the baggage cars is steel, the color conforming to the require-

ments of the Post Office Department. Double wood floors have been used and the insulation is 3-ply, No. 3 Linofelt. These cars have fresh air inlets opening behind the steam pipe at both sides and ends of the car.

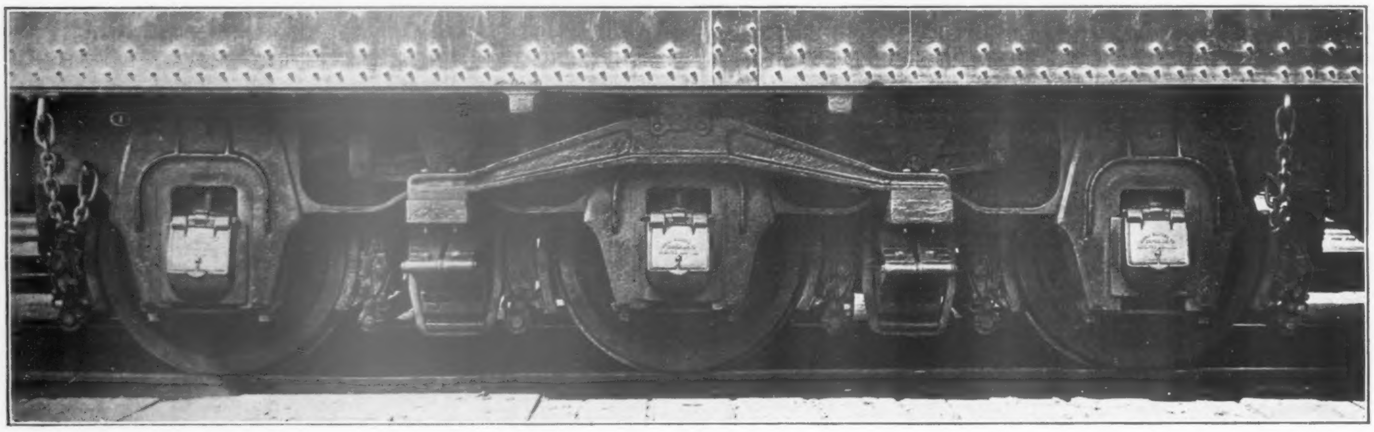
Standard type. The window fixtures were supplied by the O. M. Edwards Co. The draft gear on all the cars is the Miner friction, type A-3-P with Sharon quadruple shear couplers. The buffer is the Miner friction type B-10. Westinghouse type P S brake equipment is used with one 18-in. by 20-in. brake cylinder.



Details of Body Construction

The heating equipment in 19 of the cars is the Consolidated Car Heating Company's thermo vapor system, with direct acting steam car thermostat, while five cars have the Chicago Car Heating Company's vapor system. The Safety Car Heating & Lighting Company's underframe type electric light equipment has been applied to 18 cars, while the other six cars have Stone-Franklin underframe type electric light equipment. The coaches have the Garland exhaust ventilators, while the baggage cars are equipped with the

The coaches are carried on steel 6-wheel trucks, with 5-in. by 9-in. journals, and fitted with clasp brakes. The bolsters are carried on full elliptical springs of the usual type. The equalization system consists of semi-elliptical springs placed over the boxes and connected through short center pivoted cast-steel equalizers. The baggage cars are carried on 4-wheel trucks with 6-in. by 11-in. journals.



The Six-Wheel Truck

Shop Practice

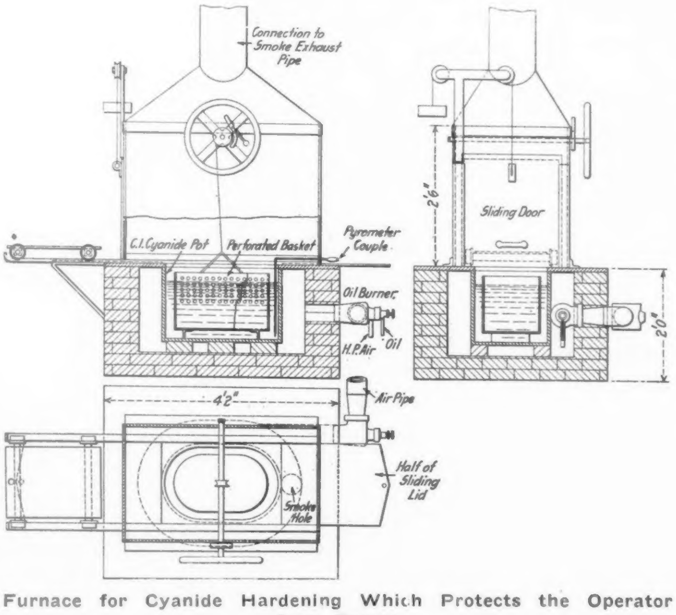
A FURNACE FOR CASEHARDENING WITH CYANIDE

BY E. T. SPIDY

The number of parts which must be casehardened in a railroad shop is so great that any system which would reduce the time required by the old bone pack method and yet enable the work to be turned out in quantities would be useful.

The cyanide casehardening furnace, described in the following, requires that the material be inserted for between 30 minutes and one hour, according to the depth of hardening desired, and the results are as good as those obtained by the bone pack method.

The furnace consists essentially of a cast iron box, which is set into a chamber lined with firebrick. The interior shape of the lining follows the outline of the cast iron pot, leaving a space 5 in. wide all around it, to allow the flame from the oil burner to circulate completely around it. The casing for the bricks is of cast iron, with a top plate made in two pices so as to facilitate rebricking when necessary. A fuel oil burner is inserted in one corner, the flame being directed around and underneath the box. The box is half filled with cyanide of potassium, which becomes a liquid on being heated. The articles to be hardened are placed in a perforated cage made of 1/8-in. steel plate and lowered into the melted cyanide by means of the pulley and handwheel, attached through the hood. It must be borne in mind that cyanide gases are poisonous and need to be carefully guided away from the operator. In this design the top of the hood is connected to the smoke exhaust system, which amply takes care of the fumes.



Furnace for Cyanide Hardening Which Protects the Operator from Fumes

By reference to the drawing it will be seen that there is a trolley and track placed on top of the furnace proper. When loading, the perforated cage stands on the trolley outside the hood, with the sliding front door of the hood closed. The articles are placed in this box in such a manner that the cyanide will reach only the parts required to be hardened. Thus, pins are stood on blocks so that the thread does not enter the cyanide (the height of the cyanide can be readily noted from the discoloration line on the cage).

When the perforated cage is fully loaded, the front sliding door is raised and the trolley pushed into the hood till the hook of the lifting cable engages the handle of the cage. The handwheel outside is now turned until the cable raises the cage and contents, which are then held in suspension by the ratchet and pawl on the handwheel shaft. The trolley is next pulled out and the front sliding hood door closed. Then the sliding doors between the rails on the top plate, which cover the top of the cyanide pot itself, are opened and by means of the handwheel the cage is lowered into the melted cyanide. After the specified time of immersion, the proceedings are reversed and the articles removed and plunged into cold water. It will be seen that this method is absolutely safe for the worker, inasmuch as he cannot possibly come into contact with the gases.

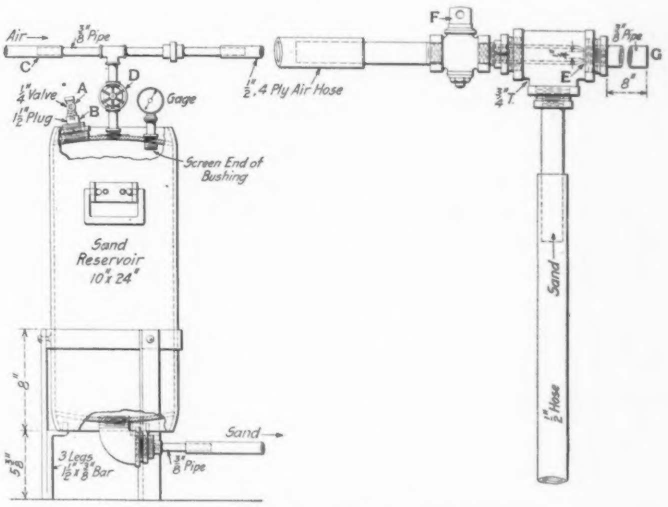
The method is entirely successful and effects a marked saving over the bone pack method or systems by which the articles are treated piece by piece. By adding about one pound of new cyanide per day, the total amount in the box remains about constant.

SAND BLAST FOR CLEANING FLUE SHEETS

BY M. K.

The necessity of thoroughly cleaning flue sheets before welding with the electric arc has led to the development of a special sand blasting machine for doing the work, which is shown in the illustration.

The reservoir has a capacity of about 100 lb. of sand and



A Handy Sand Blasting Apparatus

is fitted at the top with an air gage, an inlet valve *D*, an exhaust valve *A* and a filling plug *B*. A two-in. Street ell in the lower head serves as an outlet for the sand. The

nozzle, which imparts velocity to the sand is made of ¼-in. pipe, with the end from which the air escapes drawn down to an internal diameter of ¼ in. The sand used should be passed through a No. 8 sieve and should be free from dust.

The method of using the device is as follows: The valve *A* is opened to relieve any pressure on the reservoir and the plug *B* is removed. The reservoir is then filled with sand, the plug replaced and the valve *A* closed. The hose *C* is attached to the air supply line and valve *D* opened, admitting 5-lb. pressure to the reservoir, which is sufficient to force sand to the point *E*. The valve *D* is then closed and valve *F* opened, sand being forced through the nozzle *G* against the flue sheet. To stop the apparatus it is only necessary to close the valve *F* and open the valve *A*, relieving the pressure in the reservoir.

The entire apparatus is placed in the firebox when in use. While using this device the workman is protected by a canvas hood with a mica window and also by a respirator.

THE EFFICIENCY ENGINEER?

BY GULF

[The following incidents are true, and happened not many years ago. For very good reasons they were withheld from print, but may now be released.—Editor.]

I am not an efficiency engineer, nor the son of an efficiency engineer, though, like most men, I flatter myself that I know something of efficiency and a little of engineering, but much less in proportion to what there is to be known than I once thought. For a great many years it has been my practice to visit railway shops to study their methods and, sometimes to make recommendations. I do not think that I ever entered a shop in which, at the end of the first half day, I did not have a list of scores of things that seemed to demand an immediate revolution. Many of the practices I found were so bad, so left-handed, such blatant evidences of inefficiency, that I often wondered how the man, or men, who were responsible for them could hold their jobs. Sometimes the list increased in length during the second half day, sometimes it fell off, oftener it remained stationary. The second day I usually began to see clearer and reasons appeared for the left-handedness and seemingly awkward inefficiency. The longer I stayed and the closer I looked, the more apparent the reasons and the less in need of a revolution did things seem; at the end of a week my formidable list of the first half day had usually dwindled to nothing, or nearly so, and I felt like taking off my hat to the men in charge for accomplishing what they did. Rank inefficiency in one place may be a model of efficiency in another, because of the change in local conditions, it is useless to try to recommend changes until all of the local conditions have been studied and learned. Perhaps efficiency engineers do this, I don't know, but a mighty good rule to follow in studying a shop is to ask questions and make no suggestions, at least not until the stock of questions is exhausted, and then it won't take long to make the suggestions, because usually there will be so few of them.

* * * *

Of course, nothing is ever as well done as it might be under ideal conditions, with perfect men and perfect machines, but this combination has not yet crossed my path, and so I pin my faith to the men who are making bricks without straw, and getting good results out of the materials available. It is always well to remember that suggestions are easily made and the less a man knows of prevailing conditions, the more prolific will be his capacity to make suggestions. This is purely a statement of personal capacity and may not apply to the sublimated capabilities of professional suggestors, but I think it will hold fairly true for the ordinary man whose mind works along the ordinary channels followed by his fellows of a fair average intelligence.

* * * *

Speaking of efficiency men leads me to consider some of their ways. I believe there has been some comment as to their want of tact. Here is a true tale. A railway had a big undertaking on its hands and had a big man to undertake it. Certain plans were approved by the executive and urged by his subordinates as being just about the proper things to follow. But the big man, who was not too big to scrutinize details, suggested certain changes that reduced the cost of execution by just the snug little sum of $451,000. The revised plan was executed and when put in operation worked satisfactorily and with ever increasing economy. But the efficiency engineers by the score began to tell the president that they could save no end of dollars by reorganization, and they persisted so in their importunities that he, the president, came to think that there must be a lot in it because they all said so. So he engaged a group of seven of them to look into the details of the work of this big man, and some of the other big men on the line. It was a tough job, because a big man is usually an efficient man and things looked hard for the professional efficiency men. It was hard for them even to suggest improvements, but like labor leaders they had to do something to hold their jobs. So the chief of the whole crowd, with a big reputation, went out one night with one of his stop-watch assistants, and in prowling around the cinder pit between one and two o'clock in the morning, when work was slack and there were no engines to be cleaned, but the men had to be there, found four "Hunkies" apparently asleep. Quietly they set up the camera and, flash!—a picture was taken of the delinquent four. The flash aroused the four, and the two efficiency men fled for their lives. But the picture went to the president to show him how the big man's efficiency could be improved. Wonderful, wasn't it?

* * * *

Somewhere I have read of a question as to the honesty of this new breed of interlopers. For example, in a big plant a foundry was built. It was a good one and well designed. But after it was placed in operation, the superintendent scrutinized the cupola and felt that it could be improved. So he called in experts and they, including the builders of the cupola, concluded that better results would be obtained if it were to be lowered 36 inches. Plans were made to make the change; but it isn't easy to make such a change when there is a demand for castings, and there is a melt every day. Meanwhile the efficiency men were hot on the trail and eager to justify their existence by a suggestion. One of them was in the foundry with a stop-watch keeping tab on the time one of the men was spending in the toilet, when the foreman incidentally remarked that it was the intention to improve the cupola by lowering it 36 in. Ah, ah! there you are! The next day a report was rendered to the president stating that the present cupola was very inefficient and that it would be greatly improved by being lowered 36 in. Honest, isn't it? If it is, then Heaven guard us from the honest man.

* * * *

By the way, there is an interesting sequel to the sleeping "Hunkies." One of the same lot of efficiency men was detailed to watch the coal consumption on a certain engine test. He was to keep track of all local conditions and be on the engine at all times. A railway officer who was not an efficiency man, happening around and wanting to go where the train was going, took to the caboose and there, comfortably wrapped up on one of the bunks and snoring soundly was the efficiency man who was supposed to be an alert of the alerts and on the locomotive. He was employed by the very man who photographed the sleeping

Hunkies. Ah, woe is me when such tales are told of the very elect. But the question arises, who was the more inefficient, the Hunkey at $1.50 per day who *seemed* to sleep when there was nothing to do, or the efficiency man at ten times the Hunkey's rate who *was* asleep when he was paid for being wide awake and very alert?

* * * *

One more story of the efficiency man and I am through. After taking photographs of the tops of every tender on the line and ascertaining that there were three brooms and two shovels going to waste at a cost of two dollars, in exchange for the forty that it cost to photograph them, they tackled the aprons between the tenders and locomotives as a fruitful source of waste and inefficiency. They photographed them every one and measured the diameter of every hole and the width of every crack that existed in all these aprons, and then made an estimate of the amount of coal that could be lost through these manifold openings. Each hole and crack was credited with its own quota of the number of ounces of coal per minute that would sift through. It was frightful, it was terrific, it was a waste of unparalleled immensity. Stop and consider. Hundreds of locomotives, each with one or more streams of pure coal, coal containing 14,500 B. t. u. per pound, flowing through the aprons. Did the president "trun a fit?" Did the coal agent sit up all night? I don't know, but they ought to have done so if they didn't; for when the figures, authentic figures of the efficiency men, mind you, were sent to the superintendent of motive power he took notice and a pencil, and the result of this combination of notice and pencil was that in about two minutes—you see, he had to be efficient now, to stop the waste—he learned that in a year this awful waste of coal that had been certified to by the efficiency men had covered, or ought to have covered, the whole four hundred miles of the road with this precious coal to a depth of 11 ft. I haven't heard as to whether he wired his results to the president and asked for a special appropriation for rotary snow ploys to dig the road out, or whether from sheer chagrin at the discovery of their own inefficiency all hands were silent and let the grass grow and the tracks lie on this bed of coal, knowing that it was there and available for instant use whenever the present supply may fail.

By the way, I forgot to mention that after the photographing of the Hunkies and the disclosure of the leaky aprons, the big man who cut a half million off his shop costs and whose figures for locomotive repairs are the envy of his fellows, decided that he had had enough and resigned, and I am wondering what the road has gained by the transaction as a whole.

* * * *

These, to be sure, are trifles, little things, mere incidents in the all-embracing scheme of economy and efficiency. If ever there were a lot of men who dwelt in magnificent generalities and equally magnificent figures, it is the efficiency men, who save from $1,000,000 a day down, and who think they can prove anything. But really doesn't the efficiency man fill Josh Billings' definition of an enthusiast? "An enthusiast," says Josh, "is a man who can prove ten times as much as anybody will believe and believes ten times as much as he can prove." Then why, if they can do so much, why photograph a sleeping Hunkey?

* * * *

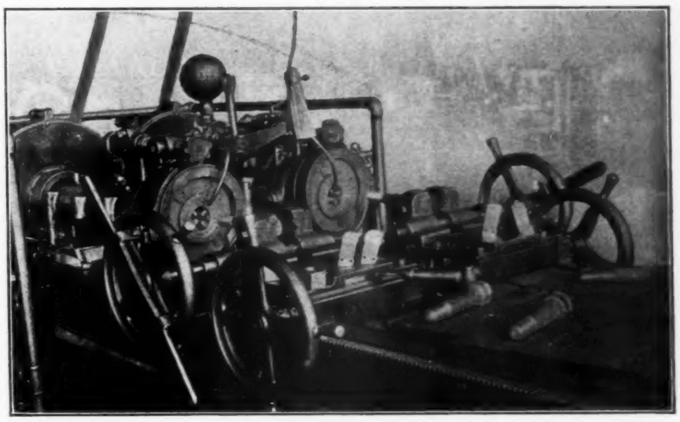
To the onlooker, the man in the street who thinks and discriminates, it seems strange, and the strangeness makes it seem impossible, that butchers and bakers and candlestick makers, to say nothing of lawyers, are so very much more wise and capable and honest than the men who have worked their way to the top by dint of hard labor and despite hard knocks; that they, without any very intimate acquaintanceship with details, can tell the men in charge how to do their work all along the line. To me it doesn't look altogether reasonable and I merely ask, is it?

TURNING BOLTS IN A BOLT CUTTER

BY ARTHUR J. HUMPHREY

An arrangement of a double-head bolt cutter which has effected a considerable saving in the making of fitted bolts is shown in the illustration. The left hand carriage of the machine has been fitted with a feed screw geared to the main driving gear and in the die head are threading dies which have had the threads ground off and the outer corners rounded for a cutting edge, thus making an effective turning head. The right hand head has the standard threading die.

The frame bolts, saddle bolts, etc., are forged in quantities, of various lengths and sizes, and are brought to the special bolt cutter, where a helper turns the ends to the proper size in the left hand head and threads them in the right. After setting the heads to the proper sizes and the stops to open for the desired length of cut, the bolts can be threaded rapidly as the operation is performed with a minimum amount of handling.



Double-Head Bolt Cutter Which Turns and Threads Ends of Fitted Bolts

The threaded bolts are kept in stock and when they are needed it is only necessary to screw a hollow threaded center over the end of the bolt, catch the head in the lathe chuck and turn the bolts to the proper size.

The single head machines will do the same work, but of course the dies must be changed and more handling of the bolts is necessary. With this special arrangement a helper and a bolt cutter will produce as much and as good work as an expensive automatic turret lathe operated by a skilled machinist.

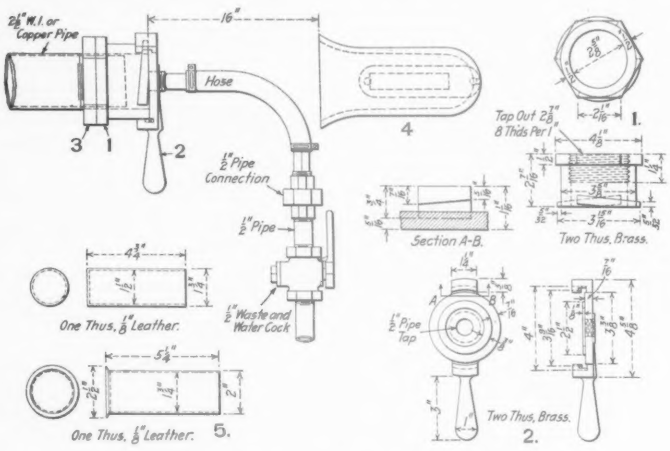
PNEUMATIC CARRIER

BY M. K.

Pneumatic carriers for conveying messages from one point to another are being used with success in many railroad shops and terminals. A simple arrangement of conveyor and receiver which can be made at any shop is shown in the sketch. The pipe line, which is placed underground, is made of 2½-in. wrought iron pipe. The brass collar on the end of the pipe is held in place by a jamb nut. The interrupted thread holds the cap, which can be tightly clamped by a slight twist that causes the lugs to grip the thread. Air from a compressed air line is carried to a conveniently located stop cock, which is connected through rubber hose to the cap.

The case in which the messages are transported consists of two leather cylinders, one of which fits inside the other, the body of the outer cylinder being somewhat smaller than

the inside diameter of the pipe, but having a base which is a fairly close fit in the tube. The receiver, which is placed in line with the end of the pipe and catches the carriers, has a small hole in the closed end to eliminate rebound of the case. When the carrier is not in use, the cap is placed to one side. When a message is to be sent the carrier is inserted, the cap put in place and the stop cock opened. After sufficient time



Details of Message Carrier

has elapsed for the message to reach the other end of the line (one to two minutes), the air is turned off and the cap removed. The chief application of the carrier system has been in sending reports from the inspection pit to the roundhouse office, but there are numerous other uses to which the device may be put.

PROLONGING THE LIFE OF FIREBOXES

BY DANIEL CLEARY
San Antonio & Aransas Pass, San Antonio, Texas

Boilers are like men. They have to be given the proper care if long life and useful service are to be gotten out of them. Locomotives all have feed pipes that deliver water from the injector, somewhere near the surface of the water in the boiler. This is for the definite purpose of heating and mixing the comparatively cold water from the injector with the hot water in the boiler as much as possible. If cold water were run in at the bottom, being heavier for a given volume than warm water, the chances are it would lie there, cutting down the circulation and causing unequal expansion in the sheets.

What is the general practice in the average roundhouse with regard to filling boilers? An engine comes in the house and stands around for an hour or so. Some light running repairs are in progress, when along comes an order for an engine as soon as possible. The fire-up man is told to "fire her up at once." He climbs up and looks at the glass and tries the gage cock, but can't find any water. This is only natural as it has been standing around some time after the fire was knocked out.. The engine is wanted in a hurry and the fire-up man knows that he must get it out so he tells the boiler washer to "fill her up through the blow-off cock."

There can be but one result from such treatment. Did you ever notice firebox sheets cracked opposite the blow-off cocks? The next time you see cracks in this location, look around and see how the boilers are being filled.

A period of 10 to 14 months of filling with cold water through the blow-off cocks will crack sheets so they will need plugging for cracks from ½ in. to 1½ in. long, whereas if the boiler were filled in the proper way, it would run for five or six years under fair water conditions. Oil-burning locomotives especially should be guarded closely when washing and filling, as it takes from 10 to 12 hours for the brick work to cool.

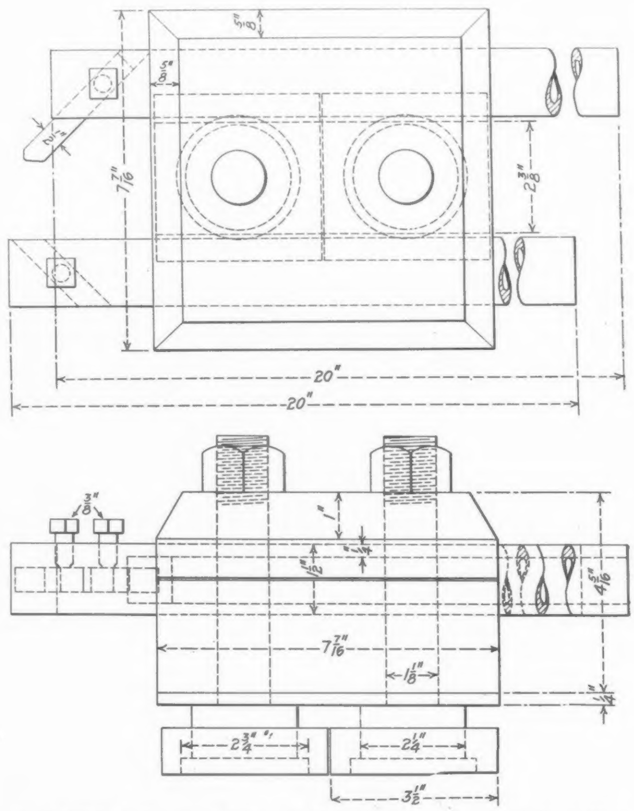
Frequently washout plugs are found on the bottom of the boiler shell about 10 in. from the front flue sheet. This has always been an eyesore to the writer. The boiler washer puts his nozzle in this hole and ties it to the brake cylinder or some other convenient location and lets the water run and as the water is running in but one direction, it merely cleans out a narrow path so that eventually it is necessary to take out 15 or 20 tubes to wash mud from the bottom of the shell. A belly washout plug like this should be patched and washout holes put in on the right and left side of the boiler above the guides; then the boiler washer may stand outside where he can hold the nozzle and throw the water all over the bottom of the shell. Anyone who has ever had the job of tapping out a boiler plug hole in this location will agree that it is a job that will try the patience of a saint.

Where it is the practice to use cold water for boiler washing or water but slightly heated from a small steam pipe leading into the washout nozzle, the boiler washers and others filling boilers get careless and do not realize the damage they do to the fireboxes. As the damage does not show up right away, they give in to the pressure of getting engines back to work in a hurry. The only safe way to hurry up boiler washing is to use a hot water boiler washing and filling system. The boilers can then be cooled down, not too rapidly, through the feed pipes, but washed out and refilled with hot water, hurrying the job along about as fast as possible.

A TOOL FOR FORMING ROD BUSHINGS

BY H. C. GILLESPIE

The lathe tool shown below has been designed especially for turning rod bushings and is so constructed that it fits in the carriage of the lathe instead of in the tool post. The



Tool Which Bores and Turns Rod Bushings in One Operation

holder carries two bars with inserted cutters held by set screws. By using this device and finishing the inside and outside of bushings at the same time, the work is performed nearly twice as fast as when a single tool is used.

Some Information on Arc Welding

The Effect of Varying Current on the Structure of the Weld, and Efficiency of Heat Utilization

BY F. G. DE SAUSSURE
Engineer, Siemund-Wenzel Electric Welding Co.

THE primary object of welding is to join together or repair parts that require strength, and therefore a question of prime importance is: How strong is a joint made by the electric welding process? In answering the question it must first be assumed that the weld is to be machined to the original section, for it is evident that by the method of reinforcing, welds can be produced that are stronger than the parts joined,

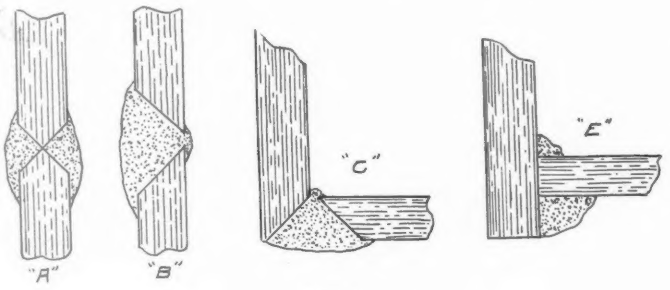


Fig. 1

merely by virtue of increased cross-section. The results of two hundred specimens show the following average results in pounds per square inch:

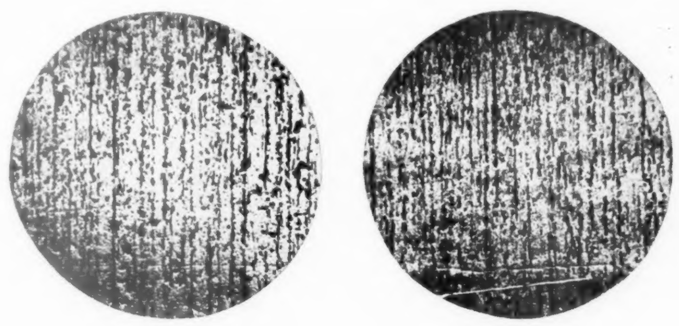
	Original.	Welded.
Elastic limit	46,900	45,600
Ultimate strength	61,500	48,585

The above specimens were bars of 1½-in. by ⅜-in. structural steel gripped 18 in. apart. The pieces to be welded were beveled on both sides as shown in Fig. 1.

STRUCTURE OF WELDED JOINTS

Sample cross-sections cut from test pieces electrically welded were magnified and photographed, and show the following characteristics:

In Fig. 2, *A*, a section of the metal entirely remote from



A *B*

Fig. 2A—Section Through Test Piece at a Point Unaffected by the Heat
Fig. 2B—Metal of the Piece Where Affected by the Heat

the joint was taken, and shows the natural "grain" of the iron; this should form the basis for comparison, as it has not been subject to the action of the arc. The effect of the heat will be seen by a careful inspection of *B* in the same figure. The more pronounced darkened laminations show the pearlite more distinctly, but there is no indication that the material has been overheated. The pearlite areas show the effect of the heat, but the arrangement may have been caused by the gradual annealing of the metal as it cooled after the weld.

The welding material itself is clearly shown in Fig. 3. The section was taken from the position indicated by the circle on the adjacent sketch, and a very distinct line marks the joining of the added metal to the original. The very dark patches indicate the presence of oxides, which results in a poor weld, as there is practically no adherence between the original and the weld when the oxide is present. This sample was made with a current of between 90 and 100 amperes and the oxide is undoubtedly the result of too low current and therefore insufficient heat used in the process.

Increasing the current results in a better weld, illustrated in Fig. 4, which was made with a current of about 125 amperes. Note that the oxide patches have diminished in size to small particles. The metal adjacent to the weld still possesses the laminated structure as was noted in Fig. 2, indicating that the heat was not great enough to harm the metal.

Still better results are shown in Fig. 5, and it is now hard

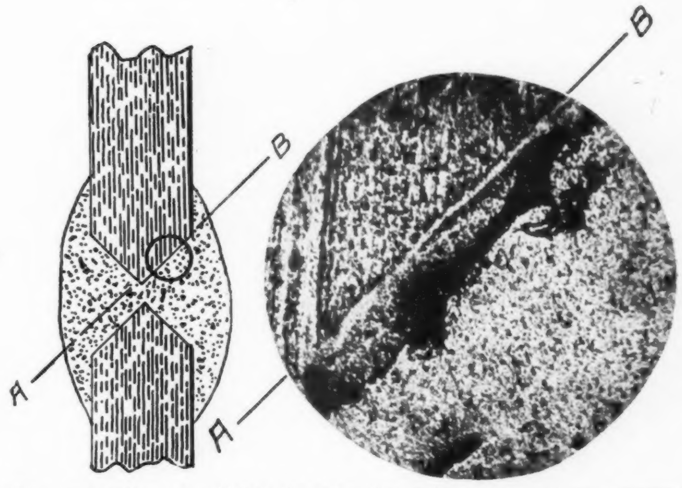


Fig. 3—Section of a Weld Showing the Effect of Too Low Current

to distinguish between the added metal and the original. This sample was made with a current between 150 and 160 amperes, and is perfect. The original metal, it should be noted, has now given up some of its laminated structure and therefore a point has been reached where a further increase of current will burn the metal.

EFFICIENCY OF HEAT UTILIZATION

It may be of some interest to calculate the heat efficiency of the process. A current of 155 amperes at 20 volts liberates 3,100 watt-hours per hour; this is equal to 3,100 times $3.412 = 10{,}577$ B. t. u. per hour liberated at the arc. A fair rate of use of welding metal is two pounds per hour, which is raised to a temperature of 3,900 deg. C., this being the temperature at the positive side of an arc. This is equivalent to 7,052 deg. F., or 6,982 deg. above room temperature (70 deg.) which, multiplied by the specific heat of iron, 0.1165, gives 813 B. t. u. per pound, or 1,626 for the two pounds used per hour, to which should be added the latent heat of fusion for two pounds of iron, 109 B. t. u., giving 1,735 B. t. u. required to fuse the two pounds of iron and raise it to 3,900 deg. C. We have shown that the energy actually expended at the arc was 10,577 B. t. u., so the thermal efficiency of the process

is 1,735÷10,577=16 per cent. This may seem rather low, but it is far higher than the efficiency of the gas weld process, which is in turn much greater than that of a blacksmith's forge.

Starting with the electrode and work cool, it is reasonable to say that the heat should be supplied at a greater rate than when the weld is in progress. However, the time required is so short that this item may be disregarded. The length and resistance of the arc vary continually, owing to unavoidable motion of the electrode, and it is important to maintain a steady current in spite of such fluctuations, to insure the temperature remaining sufficiently high to obtain perfect fusion; otherwise some particles may pass over burned, while still others will not be at the fusion temperature, producing a weld of uncertain quality, as shown in Fig. 3, previously discussed.

Probably due to the fact that the carbon arc has been longer in use and is more easily investigated, comparatively little is known of the metallic arc. One of the most striking features of the metallic arc as used for welding is that the deposit of metal is opposed to the flow of current; the operator holding the negative electrode while the positive wire is attached to the work. The reason for this is that most of the heat of an arc is generated at the positive pole. A study of Fig. 6 will more fully illustrate the relationship. The pencil electrode being of far less mass than the piece being worked on, less heat is required to bring it to fusion, consequently a good distribution of heat is obtained by making it the negative pole.

The apparent length of the arc, as viewed through the welding glasses, is ⅛ to 3-16 in., but by referring to Fig. 6 it will be noted that the molten terminals of the arc glow to such an extent that they appear to be parts of the arc itself. There is a continuous flow of molten particles from the pencil to the work, producing a metallized air gap which, when the arc is projected upon a screen, shows interesting results; it moves about, always taking the path of least resistance, and its color spectrum indicates that practically every substance coming under its influence is instantly volatilized.

EFFECTS OF THE LIGHT

The brilliance of the light and the prominence of actinic rays renders the arc highly injurious to the eyes if they are not properly protected. That a careful operator's eyes are not affected by the light as viewed through a welding shield is evidenced by the fact that men who have done such work for years do not seem to suffer any ill results. The careless operator, usually a beginner, suffers painful effects from "flashes" caused by drawing the arc without having a shield over the eyes. A good remedy for such an injury is the application of hot tea leaves with a few drops of witch-hazel on a bandage over the eyes; also wash them with a mild solution of boracic acid.

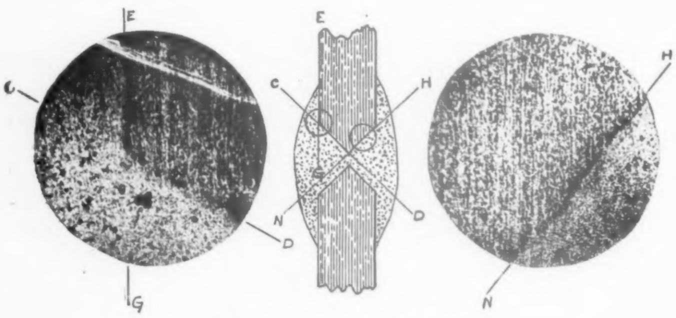


Fig. 4—Sections of a Weld Made with 125 Amperes

It is a mistake to use a shield having too light colored glass; one result is that the operator's eyes become fatigued due to the brilliance of the light, and he continually draws a longer arc without realizing it. The glasses should be of such density that sunlight is barely visible through them. Two red and one green glass make a good combination.

The operator soon learns that exposed skin is acted on by the light in a manner similar to sunburn, but much more rapidly, the exposed part blistering and peeling after a few minutes of exposure. He should not only be careful of himself in that respect, but should caution any other person within range to keep his sleeves rolled down and his wrists covered.

RATE OF WELDING

Welding is usually accomplished more quickly by the electric arc than by any other process and we give here some examples for illustration:

A full set of locomotive flues, 36 superheater and 256 2¼-in. flues have been welded in 12 hours and 30 min. by one operator. The 36 superheater flues were completed in three hours, or at the rate of 12 an hour. The 256 boiler flues were welded in 9 hrs. and 8 min., or at the rate of 27 per hour. Twelve leaks developed and required 20 min. to reweld. On the superheater flues 175 amperes were used with 20 volts at the arc, using 5-32-in. electrodes. On the smaller flues a ⅛-in. electrode and 125 amperes were used with 20 volts at the arc.

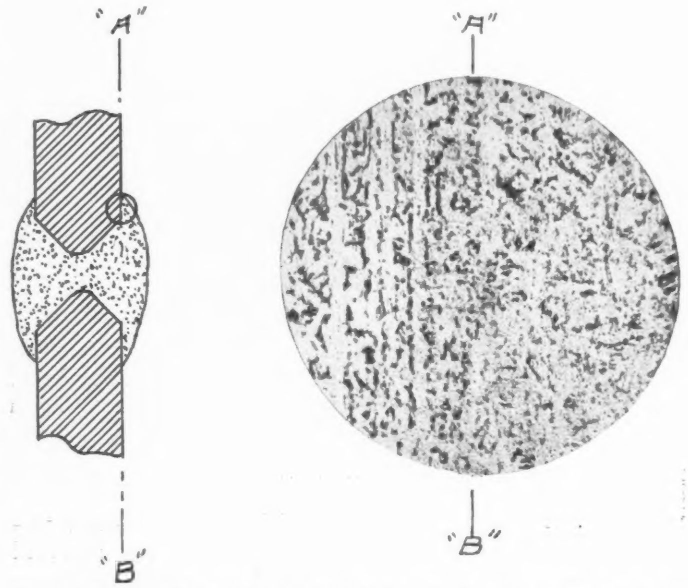


Fig. 5—Section of a Weld Made with a Current Between 150 and 160 Amperes

In a series of tests on ⅜-in. boiler plates, an average speed of 2 ft. per hour, on work in a downward position or at the sides, was maintained. On overhead work 1.8 ft. an hour was averaged. Calculations from seven pieces of ¾-in. cast steel showed an average of .83 ft. per hour.

When a welder is at work, his time may be divided into three parts: cleaning, welding and renewing electrodes. Repeated timing indicates that 10½ min. out of every hour is consumed in renewing electrodes and an average of four min. an hour is taken up in the use of the wire brush. The amount of metal deposited in an hour depends largely upon the class of work. To give some idea of this important item, the following table has been compiled:

Class of work.	Amperes.	Lb. of electrode used per hour.
⅜-in. boiler plate, downward	135	2.46
⅜-in. boiler plate, overhead	140	2.23
¾-in. cast steel, downward	150	3.12
Extra heavy shapes	175	3.28

AMOUNT OF METAL REQUIRED

It should be noted, however, that weight of electrodes used does not represent the actual weight of metal applied,

for about 26 per cent is wasted in the stub ends and there is some metal lost in the process. The waste per hundred pounds, based on a price of 6½ cents per pound for electrodes, is $1.69, minus the scrap value of electrode stubs. At this point, however, a note of warning should be sounded. Burning the electrode too near to the handle is a bad practice, while too long an electrode is also likely to result in a poor weld.

Considerably more metal must be put into a weld than is represented by the volume of the opening between the pieces. The percentage varies with the thickness of the metal. For

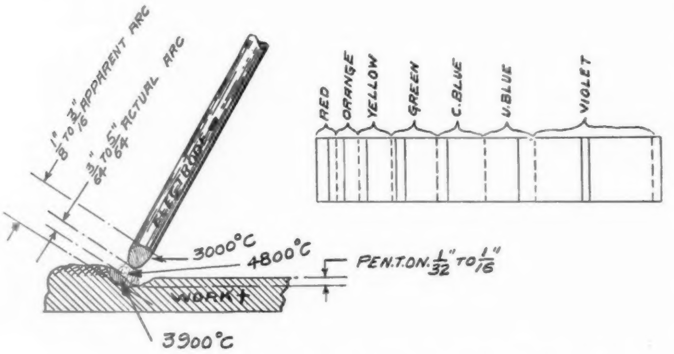


Fig. 6—Conditions Incident to the Use of the Metal Electrode

¾-in. plate add 54 per cent to the volume of the opening but add only 41 per cent for ⅜-in. plates. The following example illustrates the calculation:

Boiler plates ⅜-in. thick with a 4-ft. crack beveled out to 45 deg. on each side and left open ⅛-in. at the bottom as shown in Fig. 7. The total volume of the 4-ft. opening with a cross section as shown in the figure is 8.96 cu. in. This would require 2.56 lb. of steel to fill it, to which must be added 41 per cent, as explained previously, making a total of 3.6 lb., which must be applied. This, however, does not represent the weight of the electrodes used, as 26 per cent is wasted in stub ends; the total weight of electrodes required, allowing for this weight, is 4.54 lb. At the rate of 2 ft. an

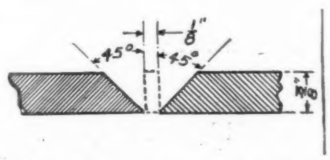


Fig. 7—Plates Prepared for Welding

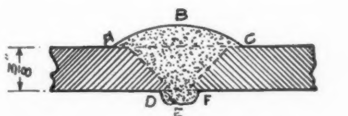


Fig. 8—Welding Completed

hour, given above, the piece should be completed in two hours; and according to the rate given in the table of 2.26 lb. of electrodes per hour, the time required should be 1.84 hours; it will be noted that the figures agree very closely. It is probable, however, that the welding would be somewhat slower than just indicated, as it is doubtful if the operator could maintain such a speed continuously for a period of two hours.

The extra metal required over the volume of the opening can be explained by reference to Fig. 8, which illustrates the completed weld. The segments *A B C* and *D E F* add a large percentage to the estimated volume, and some metal is thrown out in the form of sparks, the percentage wasted being greater on heavy work.

NOTES ON ROUNDHOUSE SUPERVISION

BY JOHN F. LONG

An old foreman once told me that the secret of success in handling a roundhouse lay in having "someone responsible for each small detail of the work." The foreman in charge is responsible for the proper performance of the men under him, but he cannot personally follow up each small detail of the entire roundhouse. It is, therefore, essential to detail the smallest operation to someone, giving him instructions on just what are his duties and, above all, being quite sure he understands the results expected.

If care is used in making this clear to a man, he enters into the performance of his assignment with a feeling that he is a party to a big undertaking, not merely filling in the hours of service necessary to earn a few dollars. More is gained by interesting a man in the work than by driving him. We are all human.

The writer spent six months in the Twenty-second Kansas Volunteers in the Spanish American war, a portion of this time being spent on special duty. He was given an opportunity to study from the point of view of a private soldier and a non-commissioned officer, the system of handling the men. The most impressive feature of this system was the obedience to the army regulations. All were thoroughly instructed daily in the regulations and a large per centage fell into a natural habit of obeying them without a thought. The men also expected the officers to enforce the laws. Everyone admires a large body of soldiers drilling, admires the way the men move in unison. There are no loud confusing commands or signs of excitement. This is explained by the fact that each individual knows exactly what is expected of him, as do the officers in charge. In fact, the men become so proficient that a private soldier could suddenly be called from the ranks to perform the duties of an officer.

Another outstanding feature of the army organization is the abundance of supervision. In a company of over 100 men, one soldier out of each eight is a non-commissioned officer who is assigned various duties and responsibilities and given a few dollars more than the private soldier. This does not weaken the company in any way, as these men carry the same kind of equipment, march in the same files with the soldiers and shoot just as fast. From this an object lesson can be drawn: ample supervision without weakening the ranks.

A foreman who assigns himself to the duty of being responsible for each small movement in the roundhouse, thereby educating his men to wait on him for instructions before making a move, makes a miserable failure of the job and lives in an atmosphere of trouble and delays. Rather educate the men each day to be more self-reliant. Then the work will move with precision, even though the attention of the foreman is necessarily centered in other directions for hours or days. One officer was heard to remark: "Yes, I visited Blank terminal the other day and I found everything moving off with regularity, the place was clean and tidy, but the thing that impressed me was the fact that the foreman, due to the illness of a member of the family, had been absent from the roundhouse a week."

It need hardly be said that here was a foreman who had taught his men to have confidence in themselves. One foreman was heard to say to his night foreman: "Billy, you have been chosen for the position of night foreman from among your shop-mates because we feel that you will make good. Now, anytime I can do anything for you, remember that I am willing to do it, no matter what it is; but I must work tomorrow and should have rest. Meet any emergency that you may be confronted with during the night, and if in the end it proves that your judgment was wrong, we will talk it over and you will not do it again." Need it be added that this night foreman made good?

What about the day foreman? Well, I heard the superin-

tendent of motive power say he was the best foreman on the system.

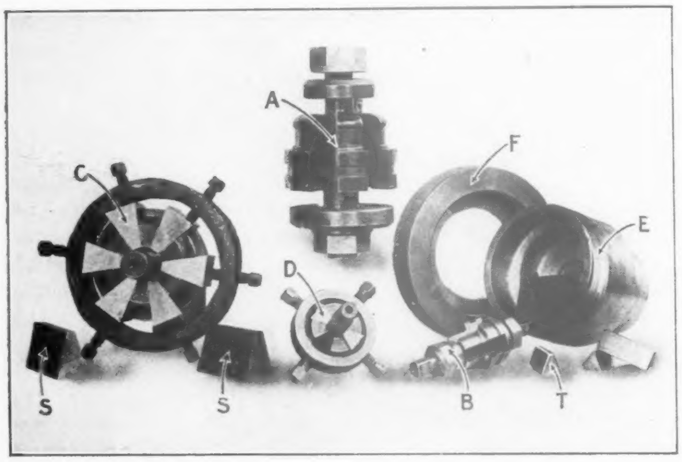
Do not construe this to mean that the foreman should turn his back on the details of the work; he should rather dig into the details of the work until the men are trained to the point where they will relieve him of the minor details. This will then give him an opportunity to concentrate his attention on the things which are giving him trouble and delaying the work. One morning a certain shop foreman, feeling that he had everything above possible criticism met the writer in front of one of the machines of the shop and began explaining what a good output he was getting from this machine; machining the product from rough to finished with six operations, completing so many in one day, and wound up by saying, with the air of a man who was perfectly satisfied with himself, "Can you beat it?"

"Yes," I replied, "that certainly looks good, but why don't you double it and cut down the number of operations?" The first important improvement was suggested by the operator of the machine. One officer, on being informed of the small operation eliminated, thought it too small to consider, but it was too late to stop this department; they were aroused, and as a final result this machine today is finishing the same piece in three operations instead of six and the output has been doubled.

METHOD OF MAKING TUBE EXPANDERS

BY F. W. SEELERT

Ordinarily tube expanders are made by turning up a solid blank to the desired shape and then slitting it into sections on the milling machine. At the Soo Line's Shoreham shops in Minneapolis, Minn., these expanders are made from beveled bar stock. Suitable size stock is selected and blocks sawed off as shown at *S* and *T*. These are the blanks with which the operation is started, and they are clamped in the mandrels shown at *C* and *D* and held in place by set screws in an iron ring. After the set screws have been tightened down and the blanks made secure the mandrel is placed between lathe centers and the sections faced off to the correct length. For the smaller sizes it is very handy to use a double tool holder for facing both ends at the same time, especially when the expanders are made in large quantities. This insures absolute uniformity in length.



Mandrels Used in Making Tube Expanders

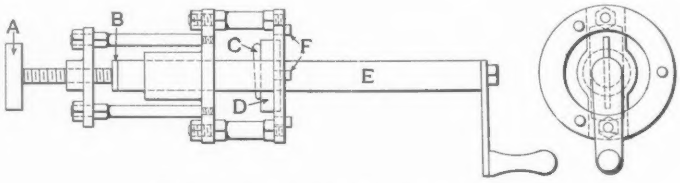
After being faced on the ends, the sections are placed in the mandrels *A* and *B*. The clamps and washers shown at the top and bottom of these mandrels are tightened down to hold the blanks in place. A series of sharp grooves will be noted on the inside face of the washers. These are for the purpose of holding the ends of the blanks in place. This mandrel is put in a lathe and the blanks are turned to the exact contour of the mandrels. These mandrels are turned from a solid piece of carbon tool steel, the recesses being slotted out of the solid piece to receive the blanks. The mandrel for making superheater expanders has six slots, while the standard tube mandrel has four; each mandrel will, therefore, accommodate half of a set of sections for a finished expander of either kind. After finishing, the mandrels are carefully hardened and drawn. At *E* is shown a cast iron chuck used in holding the section of superheater expanders while they are being bored on the inside to fit the taper expanding pin. The sections are held in the chuck by the clamp ring *F*, which screws on to the thread to be seen on the outside of the chuck. The whole chuck is screwed on the end of a lathe spindle and the taper hole is then drilled and accurately finished to fit a pattern, in order to insure interchangeability of all the sections. This operation is performed on the superheater expanders only. The smaller sizes of expander blocks are finished on the inside on a milling machine, using a suitable jig and radius cutter. After these operations are completed, all that is necessary is to remove the burrs and sharp corners and the sections are ready for hardening.

The saving effected by this method over the old method of turning up a solid blank and slotting is about 68 per cent for small expanders and about 40 per cent for superheater expanders.

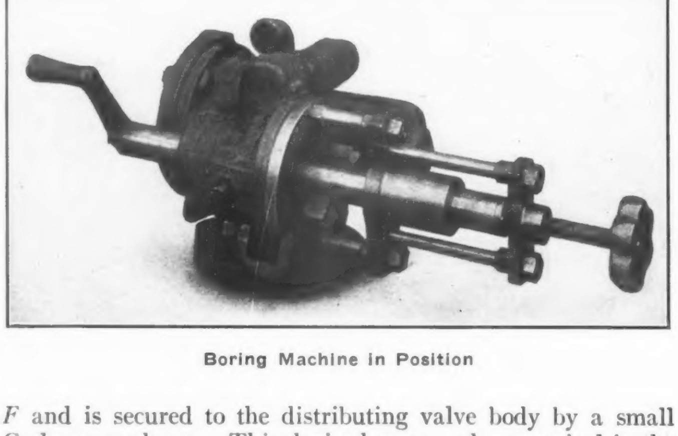
DEVICE FOR REBORING DISTRIBUTING VALVES

BY E. S. REARDON

The illustrations show a device for reboring the equalizing chamber of distributing valves, which was designed and built by the writer. The tool bar *E* is carried in a guide and has on one end a swivel nut *B*, which fits over a collar on the end of the feed screw *A*. The boring tool *B* extends through a slot in the bar and is held by the wedge *C*. When the bar is rotated it is fed as desired by turning the handwheel on the end of the feed screw. The device is held central by the pins *F* and is secured to the distributing valve body by a small C-clamp as shown. This device has proved economical in the Rutland shops at Rutland, Vt., and may be found useful elsewhere.



Equalizing Chamber Boring Machine



Boring Machine in Position

A Foreman Who Fired Himself

A Story Dealing with the Handling of Men; How Thomas Carleton Called the Master Mechanic's Bluff

SINCE the days when John McNally had been succeeded by Tom Carleton at the Greenfield roundhouse of the Y. & A. Z. things had been running with increasing smoothness, but today there was an engine off the track in the inner circle. Nothing unusual about this, as once in so often, no matter what roundhouse you visit, you will find an engine off the track in the circle. Engines seem to have a way of climbing the rail as they move off the turntable. The thing that was unusual in this particular instance, and that makes it worth a place in the chronicles of the Greenfield "roundhouse gossip," is that the engine had been off for almost an hour.

No less than 20 men were jumping around the Consolidation on this bright, but cold January day. To an onlooker it seemed as though each man spent most of his time getting out of the other fellow's way as they followed the directions of a man on one side of the engine wearing street clothes and a white collar. He evidently was not the general foreman as there was no evidence of roundhouse soot and grease on his clothes. When you noted the efforts of the men to hide their grins as, at each fresh move, the engine got another pair of wheels off the track, you were sure that he was someone in authority.

Suddenly, from the off side of the engine a new actor appeared in the scene.

"Here! What's going on. About two dozen of you fellows get back on your jobs in the house. Tony, you and Casey Jones, stay and take that frog up."

It was a deep voice, pleasant in tone, yet commanding, from the other side of the engine, and the two men in overalls did as directed without question. They recognized the voice of Big Tom Carleton, the general foreman who had captained them in many a winter's fray.

The man in the white collar was evidently taken by surprise. He looked up and his face bore a mixture of chagrin and anger that was not a pleasant thing to see. Tom, who had been home to dinner, had come back by way of the coal wharf and the outbound tracks, and therefore approached on the opposite side of the engine.

When Tom came around to see how things looked on the other side he stopped short as his eyes fell on the man in the white collar. He looked for a moment in mute astonishment. To say that the situation was embarrassing is putting it mildly. Being a man of rare native tact, Tom realized that the best he could do was to say nothing, which he did.

The man in the white collar was his superior, the recently appointed young master mechanic.

It was nearly time for several passenger engines to leave the house and with the turntable blocked, things began to look serious. Without further ceremony, Big Tom had the two men on the ground replace the blocking and the frogs after his own style, and when this was done in a matter of five minutes, he told the hostler to "give her steam." The engine went back on the track as though it were a good beast who recognized its master's voice.

When the job was done, Tom looked around, but the master mechanic had disappeared. This proved to be the first open breach between Tom Carleton and the young man who had come on the job the previous spring when the old war horse, Tom Carleton's idol, had been gathered to the land of his fathers. Just why Tom had not succeeded to the master mechanicship was a much discussed question. Tom seemed the logical man for the job, and the appointment was a surprise to every one. There were whispers about a friend of somebody else's friend "higher up," but that's another story.

The new master mechanic had arrived just after his predecessor had died in the late spring. He had kept his hands off the Greenfield roundhouse until the early fall.

The first indication of friction had come over overhauling the ash hoists. The ashes from the ash pit were loaded in cars by a locomotive crane, and one morning while Tom and the master mechanic were making the rounds Tom remarked that he was arranging to send this crane to the back shop for general overhauling. Immediately the master mechanic began to ask questions about its condition and finally suggested they take a look at it. As they climbed up the little iron ladder and stepped in the narrow doorway to the engine compartment, they all but upset the engineer, a careful fellow and extremely neat. He was up on the coal bin shining up the brass pop valve. Everything was in ship-shape, and the master mechanic could not see the necessity of giving it a general overhauling just at that time.

On returning to the office that morning, the M. M. had spoken rather sharply about the folly of taking anyone's word for a job as large as overhauling a crane, and took advantage of the occasion of forcibly calling to Tom's attention the fact that if he gave more attention to personal inspection of some other jobs about the place it would materially help to reduce running expenses. Tom thought for a minute and said:

"Well, during one winter, the first that I spent on the job, we 'got in Dutch' by neglecting the crane in the fall and ever since then we have been giving it a yearly overhauling and have not had one failure."

"But why repair it now when it is in good shape," said the master mechanic. "It's running all right and I don't see why you can't get through the winter with it."

"The very reason I want to take that crane to the shop is to inspect the parts we are unable to see from the outside. You can see what's on the outside every day, but what's on the inside you can't see unless you take it apart. Did you notice how neat the whole crane looked? The engineer is just as interested in getting that machine through the winter without a breakdown as I am and if there was anything wrong that you could see, he would have told me about it long ago. We can spare the crane a week now without any serious delay, but in the winter time when labor is hardest to get, lose that crane for an hour and we are up against it."

Big Tom's arguments were of no avail, and the crane remained in service without its regular annual overhauling, and the results were just as predicted. During the very first heavy snow storm, the main center pinion gave out, which necessitated putting on an extra gang of shovelers whose wages amounted to many times the cost of a general overhauling of the crane. To make matters worse, the master mechanic made an investigation and suspended the engineer for 30 days, claiming that the wearing out of the pinion was due to a lack of necessary attention from

the engineer. Tom felt very badly about the entire affair, but refrained from mentioning it. The master mechanic thought all the time Tom was simply laughing at him, for he felt a little guilty. However, he had made a stand and would back it up, no matter what the cost.

The next thing that happened to broaden the gulf between the two men was some work done on the superheater units of the 4984 one day, when they were short of power. It seems that this engine had a leaky unit and Tom had taken them all out for they had been in some time. He had been criticised very severely for going to all this trouble when they were so hard up for power, but Tom claimed that it was fortunate they had done so for they had found several more that looked suspicious. While going through the roundhouse in the morning, the master mechanic noticed only two men working on the re-application of the units and had suggested putting more men on the job, but Tom told him they were all the men who could work in the front end to any advantage.

"Alright," was the reply, "have your own way about it, but remember we must have that engine for her regular run tonight at seven o'clock."

In the afternoon, the master mechanic again walked through the house and saw the same two men working on the job, so he felt that there was no prospect of getting the engine out. The very next morning as the two made their regular round of the house, the master mechanic looked for the 4984, but she was gone, so he asked:

"What time did the 4984 leave the house?"

"I don't know the exact time, but it was around 6:30—she was called for seven o'clock.

"You mean this morning?" asked the M. M.

"No sir, last night."

The effect of this answer was a great surprise, for the M. M. immediately went "up in the air" and as much as called Tom a liar.

"You cannot tell me anything like that, for I saw only two men working on the engine in the afternoon and they couldn't finish all that work in time to get the engine out before midnight."

The slur in the M. M.'s remark was unmistakable. Tom wheeled so that he looked him straight in the eye as he said: "Come into the office. The clerk is going to give you the time from the despatcher."

That was yesterday. And now, today, the affair of the engine off the track had been witnessed by enough of the force to make it common property. Conditions had grown serious and no one knew it better than Tom.

Knowing that the master mechanic, because of his nasty way of acting and talking, was totally unfit to be a leader didn't help matters in the least. He was still the master mechanic and Tom realized that something was bound to break before long. One of the hardest things to bear was his continual reference to the way things were done down at Muncie, a terminal of the N. & O. Railroad.

At this time Greenfield was visited by a heavy snow storm, and things were about tied up. For one thing, they were very short of passenger engines and had nothing in sight to help out. During the previous fall, Tom had ordered steam heat and signal equipment on a few of their freight engines then going through the back shop for general repairs. The M. M. had immediately stopped the work when he heard of it. He claimed it was entirely a waste of money for their passenger power was in good condition to go through the winter, but, again as predicted by Tom, they had reached the point where it was absolutely necessary now to equip a few good freight engines with signal and steam heat lines to help out on the heavy passenger trains. As this work had to be handled by the regular roundhouse force in addition to its other regular work, it caused a serious condition that really resulted in a "tie up." Again Tom came in for the blame, for the master mechanic claimed he was negligent in not keeping his passenger power in first-class condition for winter service.

Yet the M. M. was the very man who refused to permit general overhauling of several engines, claiming they had not made nearly as much mileage as engines on the N. & O., where the roundhouse service was so good that engines were kept in road service for at least 18 months.

In order to equip the freight engines for passenger service, it was necessary to work day and night on them, so Tom remained on duty two days and all one night and the next night till nearly two o'clock. When he went home, he was completely worn out, having put in so many long hours lately, he did not get around to the roundhouse till about nine o'clock the next morning. The first man he met was the master mechanic, who immediately inquired where he had been. Tom told him of the long hours he had just put in so as to get engines to cover the passenger trains, expecting that he would receive some commendation for pulling them out of such a tight place, but imagine his surprise when the master mechanic seemed very much displeased and said that the foremen on the N. & O. always got to work on time, no matter how many hours overtime they worked. Tom was so disgusted at continually hearing about the N. & O. that, being nearly worn out trying to keep the place open, he made up his mind then and there that he would lay off and visit this wonderful place.

During the day he thought over many plans of how to make his visit but concluded if he went over as a visiting foreman, he would only get the good things, so the best way would be to go over and hire out as a regular workman; then he would be in a position to see from the inside how everything was handled. Before going home that night, he asked the master mechanic for a leave of absence of two months which was quickly granted, for the master mechanic was under the impression that Tom was working against him and that by having him out of the way, he could try out some of his own pet theories.

On arrival at Muncie, Big Tom had no trouble in securing a job as a machinist, and what a surprise for him was his first day at the new work! Where he had been accustomed to treating workmen as human beings, he found here that each man was simply recognized as a "unit" to get some one job done. Where he had his old roundhouse divided up by gangs, so that each man knew his place and had necessary tools or other equipment to handle his work in a quick and efficient manner, he found that at Muncie every job was handled in a "hurry-up-boys" manner without any regard as to whether it would hold up long enough to get over the division or not.

His first job was on an engine, the valves of which were reported blowing. He removed the steam chest covers and saw that the valve seat was so badly worn it really ought to be faced with the portable machine and then spotted down with a file, but on calling his foreman's attention to the condition, he was given a jolt by being told "never mind a thing like that, just scratch it over a little with your file so that I can swear we faced the seat if the engineer kicks."

Tom did not know what to do. He would have fired any man at Greenfield who did not go ahead and make a perfect job on a valve seat as bad as this one. In the first place, he would not permit any of his engines to get that bad before giving them proper attention, and his better judgment as a mechanic tempted him to go ahead and do a good job but he remembered now that he was simply a workman, subject to orders and had no right to do as he

thought best. So he scratched it a little on the highest point and let it go. Before he had the covers back in good condition, the foreman came up to him on the run and told him to "get the work out," for he had another hurry up job for him.

Tom's next job was on a badly cut truck journal which, he thought, should be removed, but his foreman told him to put in a new brass and plenty of white lead and the bearing would soon "come down." In olden times, he had used white lead on journals but had found from bitter experience that it did not pay, so he had not followed that practice for some years. Here at Muncie, they thought it was a late discovery in quick repairs.

Tom had decided to keep a little note book on new ideas he could pick up during his month's experience at Muncie. At the end of the first week, he had many notes entered but none whereby he could better the operation at Greenfield.

One thing he found it difficult to explain, and that was how they could keep their engine failures down to such a small number when the work in the roundhouse was handled in such a slip-shod manner. One day while he was in the roundhouse foreman's office waiting to show his boss a job, he overheard a telephone conversation between the despatcher and the foreman. The despatcher evidently was telling the foreman how an engine on a passenger train was losing time, and the foreman answered by asking the despatcher to charge the delay up against loading express or passengers like they did the other day. This gave Tom a hint of how things were handled, so when he showed his job to the boss, he asked in an offhanded manner if they had many failures, for he noticed that not many were chalked up on the board against them. "Hell yes," replied the foreman, "failures are a common occurrence on our division, but our despatcher is the right kind of a fellow and helps us out a lot." He had been given to understand that failures were an unknown quanity at Muncie, but now he realized that failures were so common, they didn't even attract attention.

At Greenfield, the engines were maintained entirely by the roundhouse force from one general shopping to the next, but at Muncie he found it was the practice to send an engine to the back shop for extra heavy roundhouse repairs. Not only that, but the roundhouse force would watch repairs in the back shop and when a complete set of rods was ready for some back shop engine, they would remove a bad set from a similar class in the roundhouse and take the overhauled rods from the back shop so that their engine received a good set with only the trouble of removing one set and applying another. The roundhouse at Muncie was full of workmen who appeared to be on the run all the time, but yet they did not handle enough actual work to maintain their switch engines. They had no system and were always in a hurry, but did not get results.

Tom had been in a supervising capacity so long that it was second nature for him to take hold of things and get results, and it wasn't very long before it was noticed how he seemed to take hold of matters better than the ordinary workman and in about three weeks after he started to work, he was selected to act as an assistant foreman. At first, Tom refused for he wanted to get all the actual experience he could during his turn of employment, but on the other hand he figured what a chance it would be for him to get in "the harness" at the point he had heard so much about and be able to straighten out some of the bad practices that he knew existed there. A couple of weeks after he took hold of the work, even the master mechanic at that point noticed the change and had him in the office, to question him about his experience.

Now Tom was loaded with questions of his own that he wanted answered and turned his visit into an examination of the master mechanic instead of being examined himself. He found that the master mechanic was not experienced in the practical side of running a big engine terminal and that he was being misled by the forces under his charge. They were taking advantage of his inexperience by "putting over" some raw deals which would some day get him into trouble. Tom could see how his good intentions to his own master mechanic at Greenfield had been lost, as that gentleman had been under the impression that everybody was trying to slip "something over on him" and would not believe that anyone was honest. Where he had been in earnest to keep business going at Greenfield, he could see how the foremen at Muncie were simply putting in ten hours each day without taking any interest in their work and thought they were successful when they could put the blame up to the other fellow. He loved his work, but at Muncie the foremen simply loved their pay.

Only about two weeks of Tom's leave of absence remained. The time had simply flown away. With the cold weather and heavy business, everyone had been driving himself to the limit. Many men were off sick with colds and the grip and the general foreman himself had said repeatedly in the last day or so that he was all in. With but a little over a week left before Tom's leave would expire, a very strange thing happened. The general foreman was taken with a serious illness, and the master mechanic sent for Tom and told him that under the condition he was going to ask him to become acting general foreman as they were in very bad shape for men. Tom started to object, but the master mechanic would not listen to him, and the result of it was that he took the job.

About this time he was enlightened as to the past training of his master mechanic at Greenfield. He had made several guarded inquiries and had been unable to learn anything about his employment at Muncie till one day he spoke to one of the old mechanics, who immediately placed him as "that kid gloved college boy with the big brown headlights." He also went on to say that this college boy had been so awkward that they had kept him in the office on report work, to keep him from harm. Tom had to smile to himself at the recommendation, for he had been given to understand that one of the most important pieces of furniture at Muncie had been this same gentleman.

As the end of Tom's leave of absence approached, he really felt sorry to leave Muncie for every one was good to him and as the general foreman had not yet recoverd from his sickness, he had the opportunity of "throwing his feet" and showing the people at that point what it was to really manage a large terminal, and the result was that business was in the best shape it had been for years.

The day Tom was going to resign to return home, the master mechanic sent for him and told him the present general foreman was going to be incapacitated for a long time, and offered him the position of general foreman at Muncie.

"We had intended," said the master mechanic, "to secure a man off the Y. & A. Z. for this position, but he seems to have disappeared, and as you are evidently well able to handle our terminal, we are glad to offer you the position."

"May I inquire who was the man on the Y. & A. Z. that you were after?"

"Thomas Carleton was his name," replied the master mechanic, "and we are very sorry that we cannot secure him, for he is one of the best roundhouse managers in this part of the country," he continued.

"Let me tell you a little story," said Tom, "before I take this job, and then if you want me I will be glad to accept your offer. To begin with, I have had several years' experience in the roundhouse and have always found that a true spirit of hon-

esty pays big dividends. I have studied the practical side of roundhouse management from "A" to "Z" and know there are many things about a roundhouse that cannot be learned from books but require long and careful study. In my last position my superior officer was always quoting the efficiency and economy of your roundhouse, so I came here to learn how to play the game both ways, and have concluded that it can't be done. There are a number of practices that exist in your shop of which I do not approve. My experience here has convinced me that I am right and that these things are wrong. Calling a spade a spade never hurts the man whose intentions are in the right direction. Paper records not based on fact will finally lead to trouble."

"Now in a way I have imposed on you, but if, after hearing me and thinking it over, you still care to give me the job, I will be glad to try it out. My right name is Tom Carleton, and I am from the Y. & A. Z. at Greenfield." Tom paused as he rose from the chair in which he had been sitting and made several steps to the door. Turning and looking square at the master mechanic he said: "I am now going to my boarding house and unless I hear further from you will take the midnight train for Greenfield." With that he hastily opened the door and passed out.

The following morning a new notice was found on the board at the Muncie roundhouse:

"NOTICE.

"Effective today, Mr. Thomas Carleton is appointed general foreman at Muncie, in charge of the entire locomotive terminal."

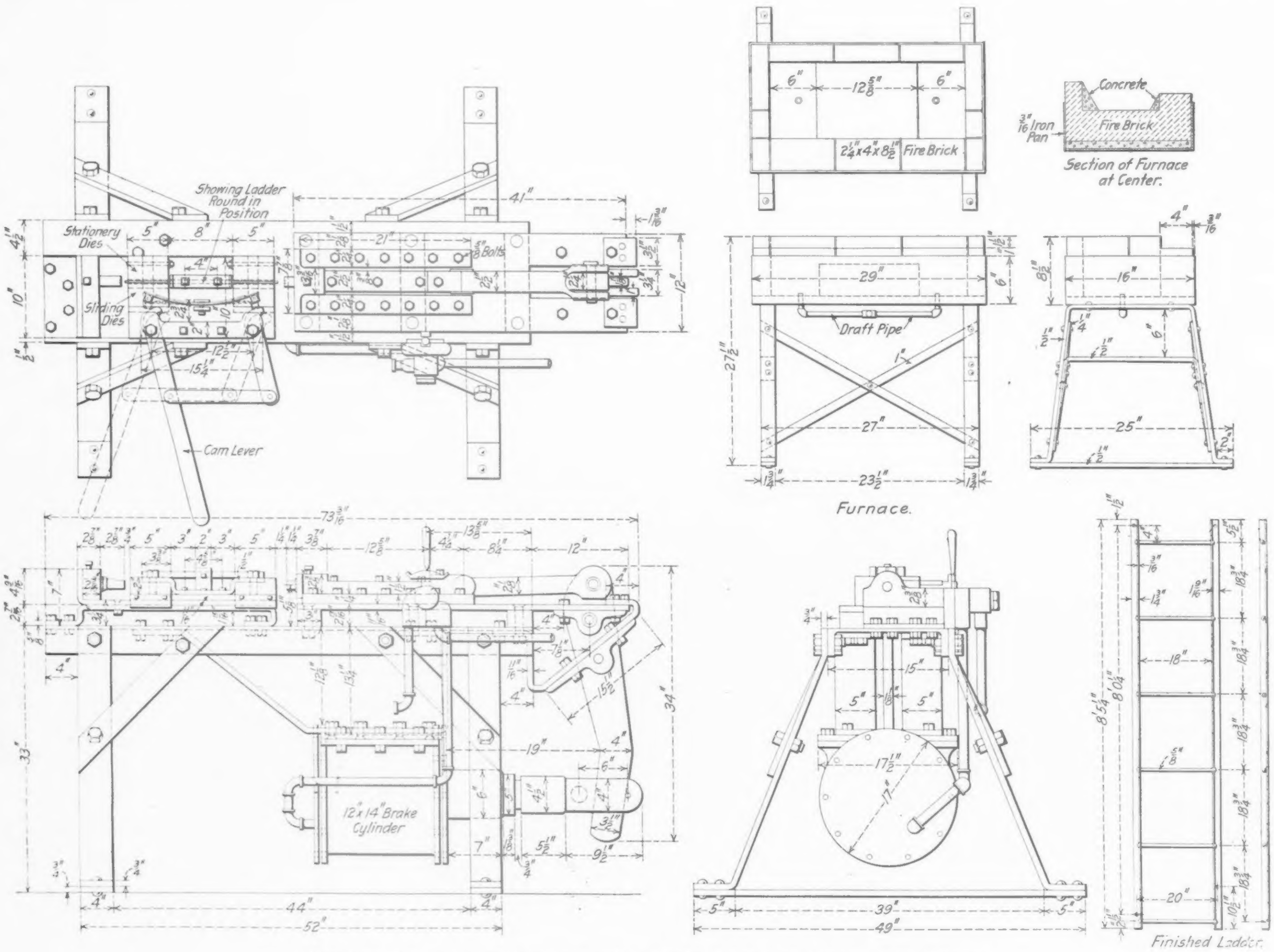
LADDER RIVETING MACHINE

BY J. H. CHANCY

Foreman Blacksmith, Georgia Railroad, Augusta, Ga.

A machine for making freight car ladders has been developed by C. M. F. Bernhardt, car department foreman of the Georgia Railroad, which has proven entirely satisfactory and with which iron ladders can be made at a cost some 35 per cent less than the price paid for these ladders in the open market.

As shown in the illustration, the machine is made from bar stock, and is operated by air, a 12-in. by 14-in. brake cylinder being used to drive it. The ladder made on this machine consists of 1¾-in. by 1¾-in. by 3/16-in. angles for side pieces and ⅝-in. rods for the rungs, the angles being spaced 18 in. apart. The rods used are taken from scrap.



Machine for Building Ladders with Angle Sides and Round Bar Rungs

The machine will rivet the rungs to both side piece angles in one operation.

The top view of the machine shows a rung in the clamps ready for riveting, the angle side pieces not being shown. These clamps slide on suitable ways so that the movable rivet die at the right will force the rod into the die at the left, thus riveting it to the side piece. The clamps are operated through a system of lever cams, and are maintained in the open position by a leaf spring. The right hand plunger slides on suitable ways on the bed of the machine, and is operated by the brake cylinder pistons through a system of levers. A three-way valve is used to operate the mechanism. A special type of furnace has been developed for heating rods at each end. This is also shown in the illustration.

New Devices

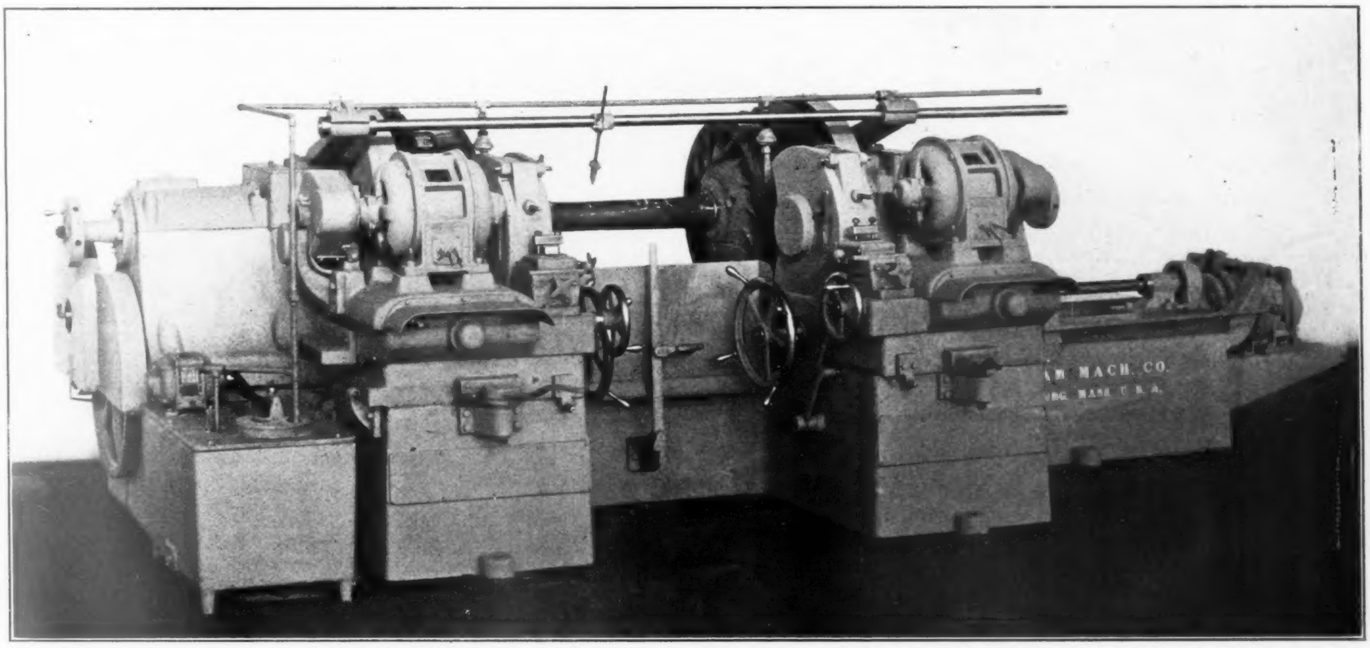
HEAVY DUTY CAR WHEEL GRINDER

A heavy duty car wheel grinder is shown in the photograph, which has a capacity of from 28-in. to 42-in. wheels and an actual swing of 44 in. on the centers. Axles up to 8 ft. in length can be accommodated.

It will be noted that this machine, which is built by the Putnam Machine Company, Fitchburg, Mass., is entirely self-contained and is driven by a direct connected motor. This machine has been designed along generous lines with a special view of combining maximum production with minimum exertion of the operator. The bed is heavy and is cross tied and braced so that it will absorb vibration due to the heavy duty imposed. The headstock is bolted solidly to the bed. The tailstock is gibbed over the outside surfaces and is provided with power movement longitudinally, the control being so located that the operator can reach it without moving from his post in front of the machine. There is also a patented clamping device that automatically clamps the tailstock when it reaches the desired operating position. The face plates are equipped with Putnam patented non-slip driving dogs which require no adjustments other than to release by hand when the wheels are in position, the engagement being entirely automatic. The main spindles are provided with adjustable sleeves, so that in chucking wheels, variations in the length over all of axles are automatically compensated and the distance between the dogs on the face plate remains constant.

The grinding wheels are mounted on high carbon steel spindles, running in tapered bronze self-oiling bearings. The thrust of the spindles is taken up by ball bearings. The base castings for grinding wheel slides are cast integral with the main bed of the machine in order to add to their rigidity and preserves the alinement. The grinding wheels may be adjusted automatically for the several standard wheel contours while the machine is running. Provision is made for furnishing cooling compound to the working faces of the grinding wheels by a motor-driven pump and necessary piping. Special pans and channels are provided to return the compound to the reservoir.

The net weight of the machine is 45,000 lb. and the equipment includes a self-contained calipering attachment for sizing wheels, as well as other accessories.



Front of the Wheel Lathe Showing Control Levers

FILE CLEANING AND SHARPENING MACHINE

A portable file cleaning and sharpening machine is shown in the photograph. It is a complete unit in itself and can be adapted to use either compressed air or steam at pressures from 80 to 150 lb. The higher pressure will, of course, cut much better than the lower pressure.

A special flint abrasive is used which can be secured at a reasonable price and may be used over and over again as long as there is any cutting action left in it. When it is too small and light for service, it flows away with the surplus water in the machine through the overflow. A brief outline of the action of this machine is as follows: A blast of air or steam carrying in suspension the abrasive flint is directed against the file, which has been introduced in an opening in front of the drum. The angle at which the file is introduced is fixed by means of guides just inside the opening, which can not be seen in the photograph. The file is slowly pushed into the drum and withdrawn a few times, the number depending upon the condition in which the file was when taken to the cleaner. The abrasive, after striking against the file at the proper angle and taking away all foreign material and leaving the file with a free cutting surface, drops into the

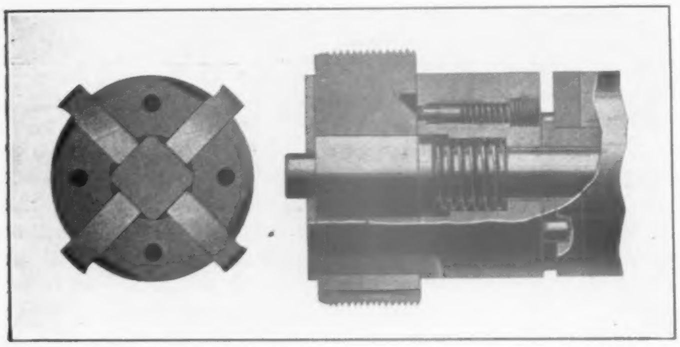
bottom of the drum. It is then ready to be syphoned up by the jet and used over again. This machine is built by the Macleod Company, Cincinnati, Ohio. It is claimed by the manufacturers that any shop using as low as 10 dozen new files each year can install one of these devices and pay 20 per cent on the investment each year. A plant using 50

Files Being Cleaned in a Buckeye Machine

dozen would pay 100 per cent on the investment, for cleaning files alone; and another feature of the outfit is that it can be used as a sand blast for small castings. There is a hand-hole in the top of the upper hopper through which the castings to be sand blasted may be introduced.

A COLLAPSING TAP

In the photograph is shown an automatic collapsing tap designed by the National Acme Manufacturing Company, Cleveland, Ohio. It will be noted that the greatest diameter of the tap is that across the chasers. There is, therefore, no



Internal Details of the Collapsible Tap

limit to the depth to which the tool may be advanced, it only being necessary to increase the length of the shank. As will be seen in the photograph, the backs of the chasers are supported for their full length against a center pin of rectangular section. When the travel of the turret is stopped at a specific point, the tap continues to cut, advancing several threads until the pins at the bottom of the chaser holder are disengaged from the holes in the end of the stationary portion of the tool. The chasers are then free to revolve with the work. As the backs of the chasers are brought opposite the flat surfaces of the center pin they collapse, due to the wedging action of the spring actuated pins against sloping sides of the recesses in their under sides.

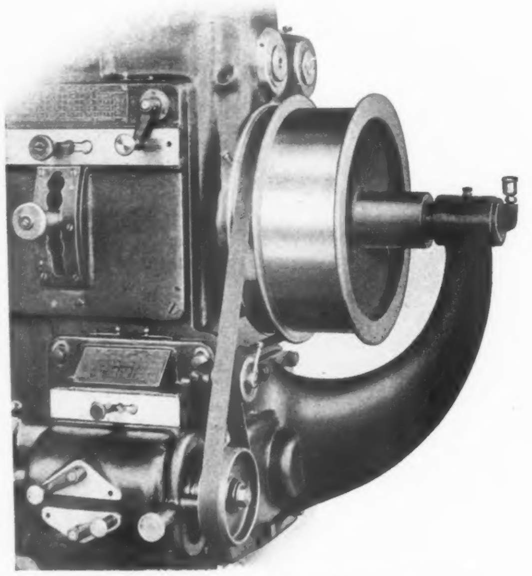
To remove the chasers for grinding, it is only necessary to loosen the top plate and the chasers will drop out. There are no openings where chips or dirt may get into the interior of the tool. All parts are interchangeable and the chasers have been tested to cut a commercially perfect thread before being placed in the tool. A graduated index provides adjustment for undersize and oversize threads when tapping for tight or loose fits.

POWER FAST TRAVERSE FOR MILLING MACHINE TABLES

A recent improvement in large milling machines is the power fast traverse for the table that is now made an integral part of every heavy service milling machine built by the Brown & Sharpe Manufacturing Company.

This power traverse will not only return the table quickly, but will advance it rapidly until the work is in position for the cutters, or will cause the table to speed up where there are spaces intervening between the surfaces to be milled. The physical exertion required to return the heavy table by hand after each cut is eliminated, the operation being performed by moving a lever conveniently located.

While this power fast traverse is an integral part of the machine it operates entirely independently of the regular

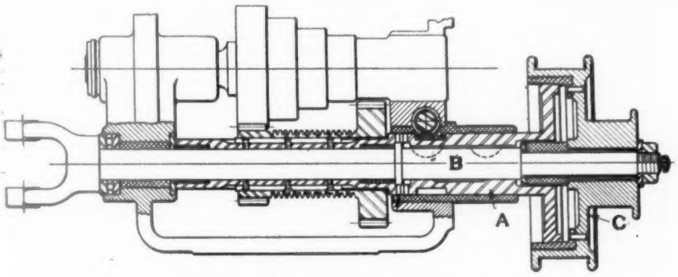


Method of Driving the Power Fast Traverse

feed change mechanism. When it is used during the time that the regular feed is engaged, the regular feed is automatically thrown out, but as soon as the power fast traverse is disengaged, the regular feed is automatically thrown into action again.

The mechanism is contained in the feed box of the machine and is driven from the machine driving pulley by a narrow belt. The diagram shows the arrangement of the mechanism. The sliding sleeve A is keyed to the shaft B, that delivers the power from the feed case to the telescopic shaft leading to the feed mechanism in the knee and saddle. On one end

of sleeve A is a toothed clutch and on the other a friction clutch. When the toothed clutch is engaged, the drive is through the regular feed changing mechanism, and when the controlling lever is thrown over to operate the fast traverse, the sleeve A disengages from the regular feeding mechanism and the friction clutch at its opposite end is thrown into the



Mechanism of Power Fast Traverse

fast traverse driving pully C. The drive is now direct from this pulley to the feeding mechanism in the knee and saddle, and since the fast traverse driving pulley is belted directly to the main driving pulley of the machine, the movement of the table is greatly accelerated.

The friction clutch and narrow driving belt are intended

Operator Throwing Power Fast Traverse Into Action

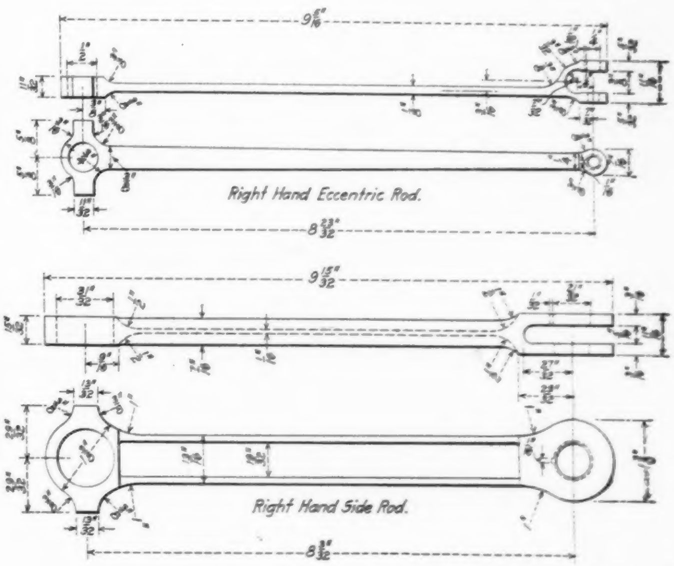
to prevent damage to the machine or cutters in case of the work running into the cutters when moving the table up at the beginning of a cut. It is not intended, however, that the operator should depend on this to prevent damage, for while not probable in most cases, it is possible sometimes to break small or delicately made cutters in this way.

REVERSIBLE ECCENTRIC AND SIDE RODS

The necessity for carrying side rods and eccentric rods in stock in pairs, right and left, ties up a considerably larger amount of material than if one rod could be made to answer both purposes. Of course, if a rod should be required for the left side and only rods for the right side were in stock it would be possible to cut the rods, turn one end 180 deg. in relation to the other and weld together. Valuable time might be lost in doing this, however, and there would always be the possibility of a poor weld, especially if the operation was performed at an outlying point.

One thing only stands in the way of using the rods indiscriminately and that is the oil cup. Three employees of the locomotive repair machine shop of the Delaware, Lackawanna & Western at Scranton, Pa., all of whom have had extensive experience in rod work, realizing this have designed and patented, and have in actual use, rods which have oil cups forged on both sides of the rod as indicated in the drawing. This adds only a small amount to the weight of the rods and requires some additional machine work. The slight added expense is offset many times by the advantage of a reduction of 50 per cent in the amount of stock which must be carried and in added convenience.

These advantages are made almost immediately available



Eccentric Rod and Side Rod Which Are Reversible

if the reversible rods are placed in stock as the present stock diminishes. The patentees are Charles E. Weitaw, William R. Owens, and H. R. Jones, all of the above mentioned address.

UNION AUTOMATIC TRAIN PIPE CONNECTOR

Any automatic train-line connector that is to be used extensively should not only provide an automatic means of connecting up train, signal and steam lines, but should provide a means of easily restoring the present manually operated coupling, for use with cars not provided with automatic connectors.

A connector embodying this feature and known as the

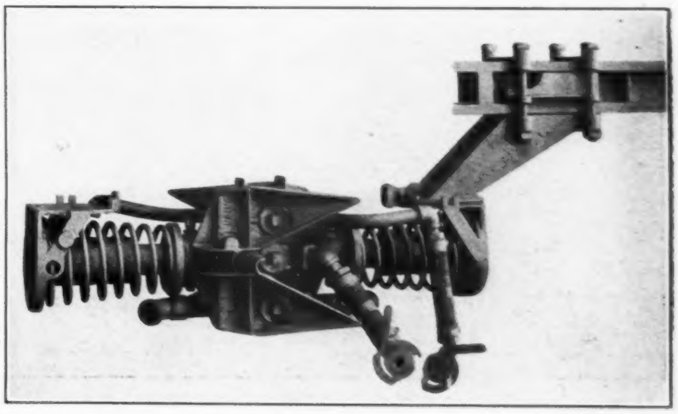


Fig. 1—Method of Attaching to Three-Stem Passenger Coupler Shank

Union connector, manufactured by the Union Automatic Connector Corporation, Jackson, Miss., is shown in Fig. 1. The connector is here shown attached to a three-stem coupler shank for passenger service. It will be seen that the connector is suspended independent of any other equipment, and

that the space occupied is that usually occupied by the ordinary manually operated couplings. As will be pointed out later, this method of attachment is to take care of the transition period while both automatic and non-automatic connectors are in use, and when that is passed, specially designed drawheads will be provided for taking care of the equipment, eliminating the present interchange features and the steam hose. As will be noted in Fig. 2, the Union connector is of the side-port type, that is, the gasket faces are in a vertical plane nearly parallel with the longitudinal center line of the car. In this photograph one of the cages, which can be seen

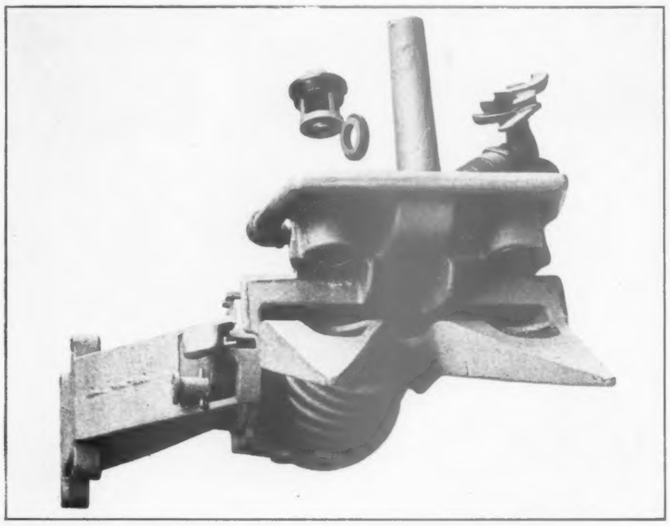


Fig. 2—Front View Showing Gasket and Cage Removed

from the side in Fig. 1, has been removed. The end of this cage is the rear support of the gasket, which can therefore be removed and replaced without breaking the connection between two cars, by merely unscrewing the cage as shown. In the case of the air and signal gaskets, the cage and gasket are designed so that the gasket has a snug fit in the bottom of the cage. This facilitates the application of new gaskets, as

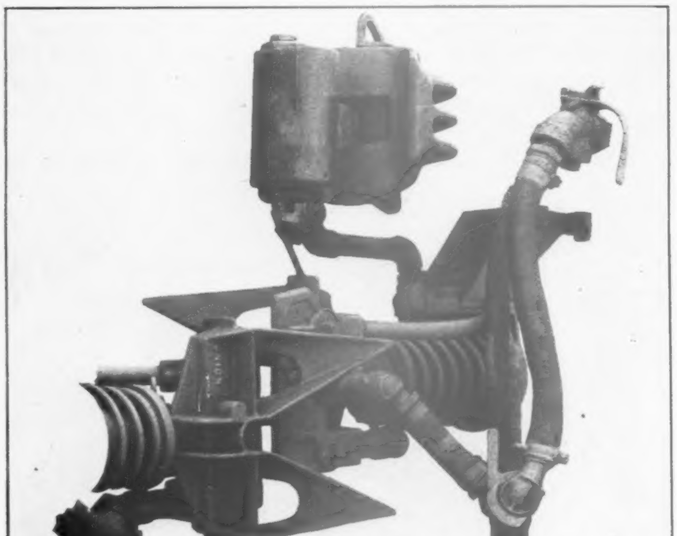


Fig. 3—Coupling with One Connector 4½ In. Low and 3 In. Off Center

after the gasket is seated in the cage, the latter can be screwed into the coupler without the exercise of special care.

While the air and signal gaskets fit closely against each other, the steam gaskets do not touch, but are slightly loose in their seats before the steam is turned on. This allows the condensed steam to drain out when steam is first turned into the line, thus obviating the use of troublesome drip valves. The steam gasket and follower are arranged to expand as the temperature is raised, thus securing a tight joint. Fig. 3 shows two passenger heads about to couple, one of them being 4½ in. lower than the other, and horizontally off cen-

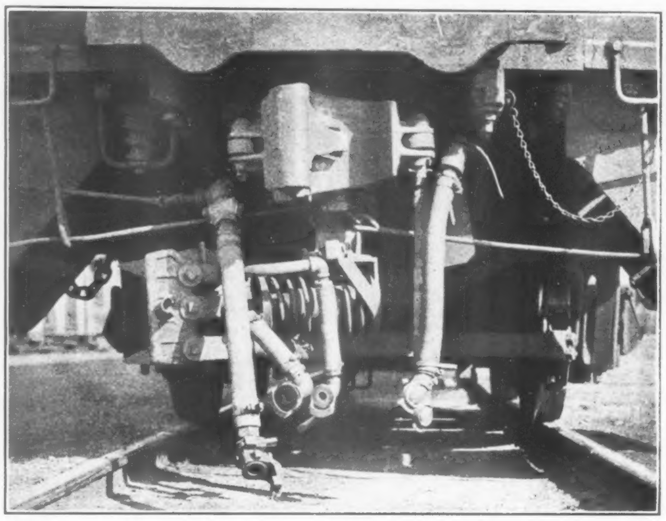


Fig. 4—Connector Turned and Locked in Non-operative Position

ter about 3 in. It will be noted from the shape and angle of the horns engaging the post and also the broad tongue opposite the pocket, that the two connectors are thrown into position when the cars are brought together. The connector has a 10-in. horizontal and 11-in. vertical gathering range. Free movement is obtained through the means of a pin and a telescoping mechanism around which will be noted a coil spring.

When the heads have been coupled by the interlocking of

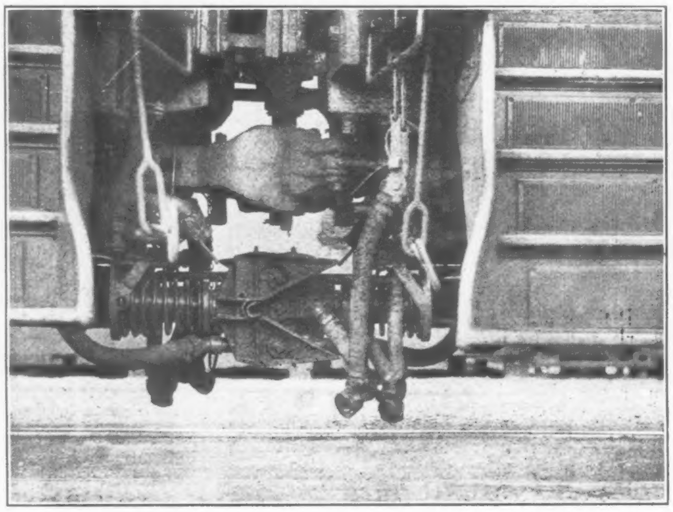


Fig. 5—Side View of Two Passenger Cars Coupled

drawheads, each spring has been compressed 2½ in. to 3 in., producing a tension of about 150 lb. each. After being coupled, the design of the various engaging surfaces is such that the heads lock themselves and no locking mechanism is provided. No movement of the heads relative to each other is possible while they are coupled, a long gasket life being thus assured.

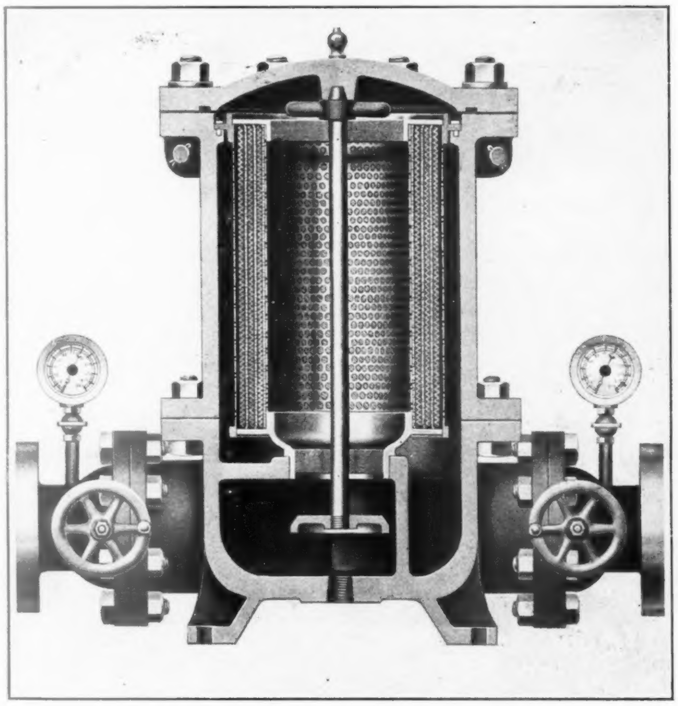
While the heads are rigid relative to each other, freedom of movement of the two heads acting as a unit is provided in the telescoping and pin mechanism above mentioned. The gaskets are not in a plane exactly parallel with a vertical plane through the center of the coupler yoke, and the connector engaging surfaces are so arranged that the gaskets on

either of the couplers never touch until the coupling is completed, this being the last part of the operation. There is therefore, no tendency to knock the gaskets out of place or ruin them by abrasion. The photograph shown in Fig. 4 illustrates the way in which the coupler heads may be swung out of place on a turntable. This turntable, at the bottom of the connection up to the coupler yoke, has two locking positions, one with the connector in operating position and the other in the out-of-service position. To entirely remove the equipment from a car, it is only necessary to throw out the turntable pin, lift the latch and unscrew the steam hose union.

Two passenger cars coupled with full equipment are shown in Fig. 5. The ordinary steam heat hose in this picture has been removed in order to allow a clear view of the coupling. In installing this equipment it is necessary to introduce a three-way cock back of the present steam heat cock at the end of the line. This is used in place of the old steam heat valve and is arranged so that it can be operated from the vestibule of the car.

FILTER AND GREASE EXTRACTOR

A filter and grease extractor is shown in the photograph, which consists of two chambers, each containing a single filtering element in the form of a spool on which a length of Terry linen is wrapped, with the layers separated by alternate layers of a wire mesh spacing mat. It is designed for the filtration of boiler feed water and made by the Lagonda Manufacturing Company. All of the water is filtered and refiltered through five layers of the filtering cloth, obtaining the removal of suspended solids, oil and grease. This effective filtration is secured with a minimum drop in pressure as the velocity of the water is greatly reduced when entering the large filter chambers.



Sectional View of the Grease Extractor

Gate valves at the inlet and outlet control the chambers and the latter may be cut into or out of service by simply shifting these valves. The usual method of operation is to have one chamber in service at a time with the other one held in reserve. Then when it is necessary to clean one chamber, the valves are shifted and the reserve chamber is thrown into service and the other may be opened and cleaned. Thus there is always a continuous supply of clean water furnished to the boilers and there is no by-pass necessary and none is provided. Advantage may be taken of the double capacity of the filter in time of overload or unusual condition requiring more water, when both chambers may be thrown into service.

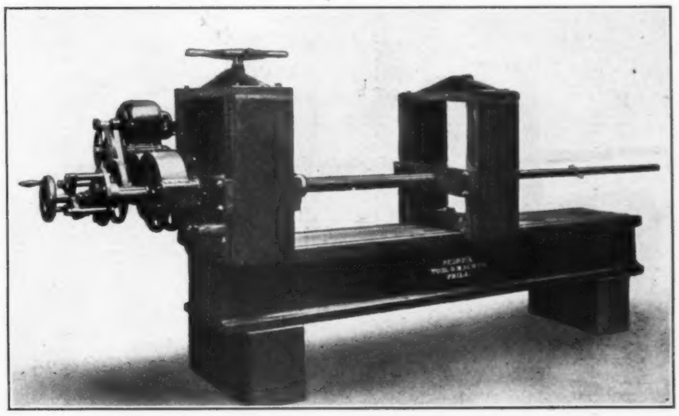
Cleaning is accomplished by unrolling the fouled linen from the spool and replacing it with a clean extra length which is furnished. The dirty linen can be washed and used over repeatedly. The filter spool is lifted from the filter chamber by means of a handle at the top of a valve stem. As the spool is lifted out the valve closes the bottom so that all dirt which has accumulated within the core of the spool is lifted out with the spool itself. When the filter is in operation, this valve is held open by the cover which engages the valve stem.

An arrangement for flushing out the filter chambers without removing the cover is provided, pipe connections being located near the top of each chamber for a water supply. Blow-off connections are at the bottom of each chamber. All internal parts are of bronze and the complete machines are tested at a pressure 50 per cent in excess of that at which they are to operate.

PEDRICK HORIZONTAL BORING MACHINE

A novel type of horizontal boring machine, which has been developed by the Pedrick Tool & Machine Company, Philadelphia, Pa., retains several of the inherent features of the portable boring bar manufactured by the same company. Although of simple construction, the machine is adapted to use on a wide range of work.

This machine consists of a heavy substantial bed having a T-slot on each side of the upper surface. Two housings are fitted to the bed and are movable to suit conditions. On both sides of the housings are T-slots, by means of which the bar supports are held in position at suitable heights above the bed. The main bearing for the boring bar is a long quill, with crossheads at both ends. These are bolted to the front housing on both sides and give unusually rigid support. The quill is bored to fit the bar and the cross members are faced from the bore, so that proper alinement of the bar is assured wherever it may be located on the housing. The handwheel shown in the illustration operates the elevating screw for raising or lowering the bar to the desired height. A ball thrust bearing makes this adjustment easy.



A Simple Horizontal Boring Machine

The boring bar is driven through variable gearing, so that the speed can be readily adjusted for boring holes of different diameters. The feed case, located on the end of the boring bar, provides constant automatic feed, with three speeds in either direction. The feed screw, in a recess on the boring bar, permits of longer continuous feed than the usual travel-

ing bar affords. Quick return of the bar is secured by removing the half feed nut and sliding the bar through the bearings.

For boring or drilling holes smaller than the main bar a taper hole in the end of the bar is provided, so that this machine with a 3-in. bar will bore any hole up to 16 in. in diameter. If the hole to be bored is large enough for the convenient operation of the main boring bar, the work is placed on the bed, the bar with the proper size cutterhead on it is pushed through the hole and through the rear bearing on the back housing. Thus the bar is rigidly supported at both ends and the cutterhead travels along the bar, boring the hole to the diameter wanted. If the hole to be bored is smaller than the main bar, auxiliary bars are used. In this case the main bar travels and feeds the smaller bar.

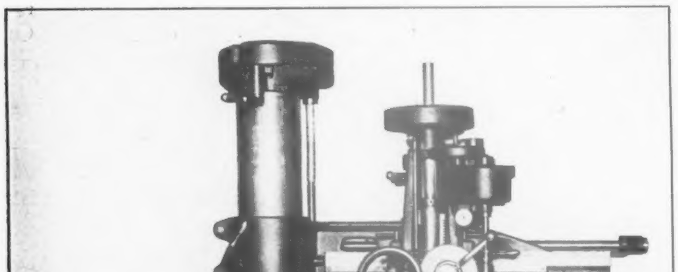
A table at right angles to the bed, with a cross slide, is provided and adds considerably to the convenience of handling various classes of work.

This boring machine is being built with bars of several diameters, depending on the work for which the tool is to be used.

RADIAL DRILL

In the photograph is shown a radial drill built by the Morris Machine Tool Company of Cincinnati, Ohio. It will be noted that this drill has a column of substantial proportions, which swivels on roller bearings in a stump securely bolted and doweled to the base, and projects deep enough in the stump to insure alignment under heavy strains. There is also provided an arrangement to take up wear in the column bearings.

The arm and arm bearing are of generous proportions and



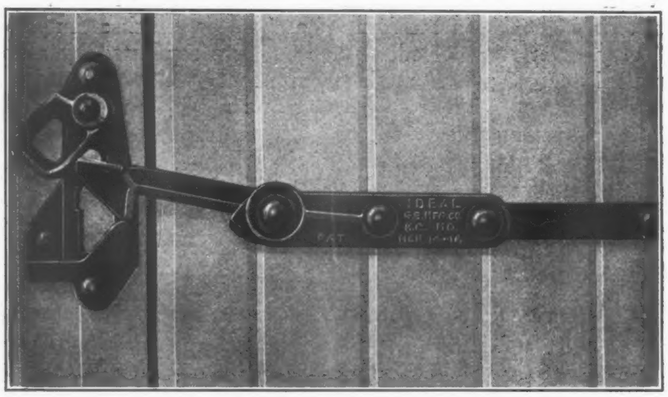
Drill for General Heavy Work.

are provided with an arrangement for taking up wear. The arm is clamped by one lever, convenient to the operator. It is raised and lowered by means of a screw operated by tumbler gears that are engaged by a handle within easy reach of the operator. These gears are so arranged that they have a tendency to disengage, thus forcing the operator to retain his hold on the handle while the arm is in motion. If, by any chance, the arm should reach the extreme position before the elevating handle is released, the gears would automatically disengage themselves and the operator could not hold them in mesh. The head is traversed by means of a rack and pinion and the hand wheel on the left side of the arm.

All gears are of steel and are covered. The back gears are engaged or disengaged while running, by a lever at the left of the spindle. The spindle is a hammered forging of high carbon steel, the thrust of which is taken up by a ball bearing. Ten spindle speeds are secured on the cone drive and a 12 on the speed box drive. A direct reading depth gage and automatic feed trip is furnished. The clutches are heat treated and hardened, and the bearings are of phosphor bronze, arranged with oil chambers and felt wipers. The machine weighs about 3,500 lb. Either motor drive or belt drive can be furnished.

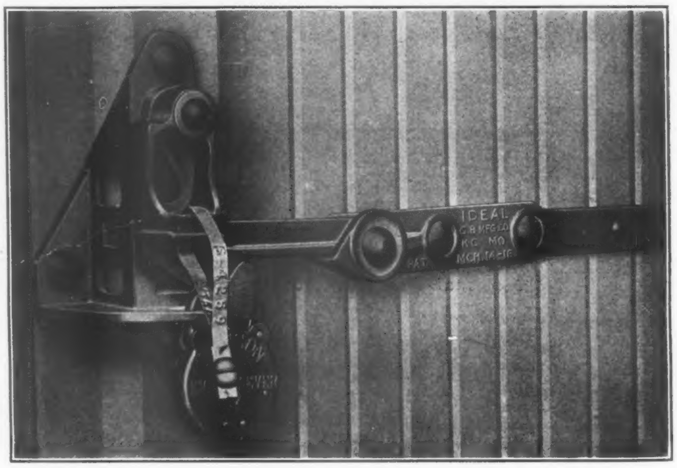
AUTOMATIC FREIGHT CAR DOOR LOCK

The accompanying illustrations show the Ideal automatic freight car door lock made by the Gustin-Bacon Manufacturing Company, Kansas City, Mo. One view shows the door shut and locked, and the other shows the door just about to be closed and the action of the lock just before the hasp drops into place. It will be seen that as the beveled end



Automatic Freight Car Door Lock with Door About to Close

of the hasp strikes the catch casting it slides up and drops into place, allowing the locking casting to fall into place. When the door is pushed shut the lock automaticaly runs into position for sealing, and eliminates the necessity of using a bolt or pin seal. This automatic feature is of special interest as a good many times difficulty is experienced in holding the door closed on some of the cars while the seal



The Lock Closed with Seal and Padlock in Position

pin is being put in place. This lock automatically fastens the door the first time it runs shut. It is made for wood or steel cars, and consists of two assembled malleable castings

which are easily applied. The illustrations also show that a padlock may be used in addition to the door seal.

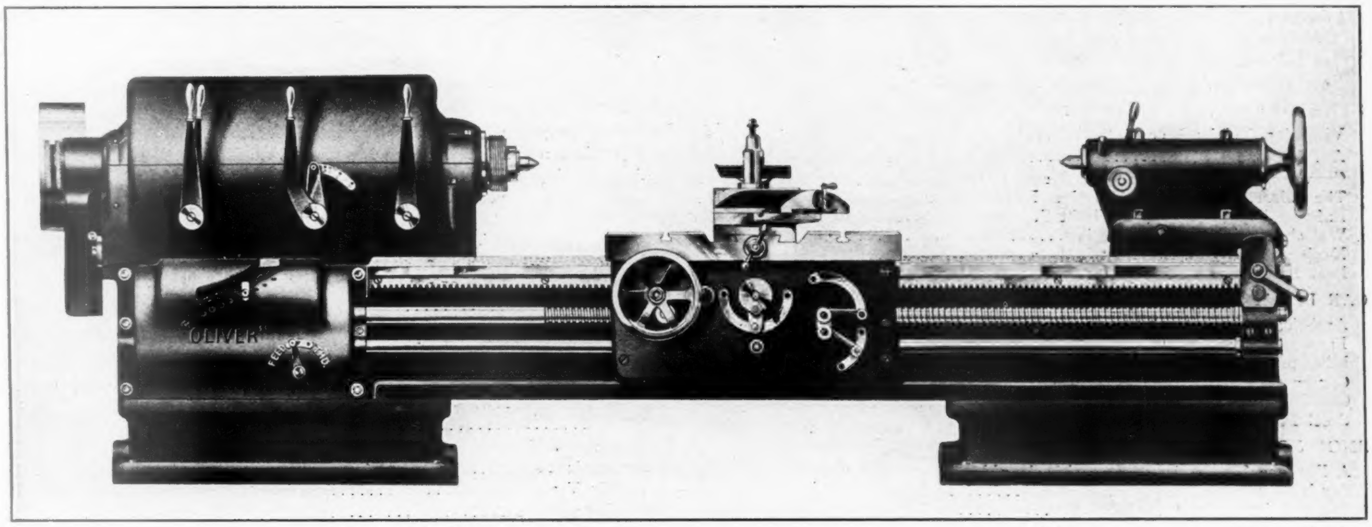
HEAVY DUTY ENGINE LATHE

In the illustration is shown an engine lathe built for extra heavy duty and with the idea of making it powerful enough to completely utilize the capabilities of high speed tool steel. It is built by the Oliver Machinery Company, Grand Rapids, Mich.

The headstock is long and heavily ribbed and has a long bearing on the lathe bed. The front spindle bearing is 6½ in. by 10 in. and the rear 4½ in. by 7 in. There is a range of 12 spindle speeds from 8 to 300 r.p.m. All gears are cast steel of large pitch diameter and wide face and run in oil. The pinions are steel forgings. The spindle is a high carbon steel forging, accurately ground and the spindle nose is of such design as to permit easy threading or removing of the face plates. The speed control levers are large and are so arranged that they can easily be reached. The spindle speeds are selective.

The tailstock is moved by means of a geared crank and it is made long in order to secure a good grip to the bed when it is clamped in place by four hardened nuts. The bed is of substantial design, the span being 23¾ in. over all and is braced by box sections. The length of the carriage is 40 in. and the span of the bridge is 12 in. over all. The carriage has a regular feed hand wheel, which is used when the carriage is in position to take a cut and also a rapid motion crank used for making rapid changes.

The apron has a removable front plate, permitting easy access to the entire internal mechanism. Both longitudinal and cross feeds are friction drive and can be thrown into action by means of the same lever. Both feeds cannot be thrown in at the same time and the feed mechanism cannot be thrown in when the lead screw is in operation. The crank for moving the carriage by hand is geared by means of compound gears to the rack pinion, so that the heavy carriage and apron can be operated as easily as that of an ordinary 16-in. lathe. All gears are of forgings or steel castings. All bearings are bushed with bronze.



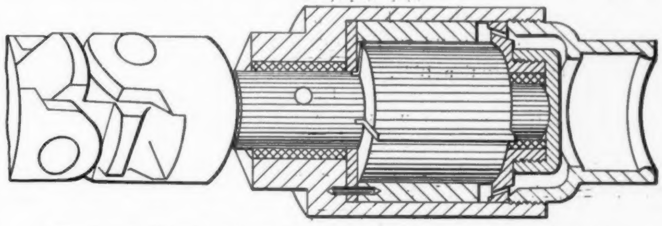
Front of Engine Lathe Showing Control Levers

The feeds and threads are controlled by the quick change gear box. There are 33 feeds ranging from .013 in. to .333 in. per revolution of spindle, and 33 threads, ranging from one to 16 per in., are obtained by simply changing the lever positions as indicated on the table on the gear box. The gears are steel and the bearings bronze. Changes may be made while the machine is running.

The headstock is designed for individual constant speed motor drive and either direct or alternating current. Seven and one-half to 15 hp. motors are recommended with a limit of speed of 600 to 900 r.p.m.

THE DETAILS OF AN ARCH TUBE CLEANER

In the illustration are shown the details of a Lagonda Arch Tube Cleaner. This tool is of particular interest because of the principles involved in its internal construction. It will be noted that power in the form of compressed air or steam is introduced into one end of the tool through suitable holes and couplings. Two ports are provided, 180 deg. apart for introducing the power into the rotor. The rotor is provided with four steel blades, placed 90 deg. apart and working in slots in the rotor. These blades are forced out against the inside casing of the tool which is elliptical in cross section, so that when the rotor revolves, the blades are moved in and out of their slots. This provides a means of getting pressure against one side of the blades and driving the rotor forward, the steam or air being released to the atmosphere through two exhaust ports, placed at angles of 90 deg. from the supply ports. The blades are always under pressure so that there is slight possibility of the cleaner becoming stalled in the tube, if properly operated.



Drawing Showing the Inside of the Arch Tube Cleaner

These cleaners, made by the Lagonda Manufacturing Company, Springfield, Ohio, are said to have an air consumption of 45 cu. ft. of free air per minute at 60 lb. pressure. For best work they should be operated with air or steam at 60 or 80 lb. pressure. The cutting tools are attached to the rotor by means of a universal toggle joint, so that the machine will pass easily around the bends of the tubes.

Effect of Soot in Boilers.—A scoop of slack coal will convert 120 lb. of water into steam in any well-kept boiler. If the flues and flue sheets are covered with ⅛ in. of soot it will only evaporate 66 lb. of water.—*Railway and Locomotive Engineering.*

Railway Mechanical Engineer

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WE GUARANTEE, that of this issue 9,036 copies were printed; that of these 9,036 copies 7,687 were mailed to regular paid subscribers, 112 were provided for counter and news companies' sales, 529 were mailed to advertisers, exchanges and correspondents, and 708 were provided for new subscriptions, samples, copies lost in the mail and office use; that the total copies printed this year to date were 18,136, an average of 9,068 copies a month.

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The House of Representatives recently passed the post-office appropriation bill without the provision for an increase in the rates for carrying second-class mail matter.

In a fire at Lima, O., on January 19, the main building of the car shops of the Cincinnati, Hamilton & Dayton was destroyed; estimated loss, including 10 passenger cars, $200,000.

The Southern Pacific Lines in Texas are now using the self-locking Tyden freight car seal. Lead and tin seals requiring the use of a seal press have been abandoned, and agents and conductors are called upon to be able to report, at the end of a year, the results of their experience with the new seal, so that it will be possible to make a comprehensive report of the results of the year's trial.

Inter-car telephones were used recently on the Pacific Coast Special, which made the trip from San Francisco to the convention of Willys-Overland dealers at Toledo, Ohio. A daily newspaper called the Overland Daily Speed was published en route, being edited by newspaper men aboard the train. The printing work was done on a small press in the baggage car.

A new dining car has been placed in service on the Illinois Central with improved sanitary features. This car is provided with an efficient ventilating system for the kitchen which prevents all dust and cinders from entering the car and still provides proper ventilation. The receptacle for milk and cream is kept clean by means of a continuous flushing arrangement, and the fish is kept in a separate refrigerator. There is a fan to drive cooking odors to the rear platform, keeping them out of the dining room. The car has no platforms and there are tables for thirty-six passengers. Cars of this type cost about $30,000 each, including the special equipment.

INCREASE IN M. C. B. REPAIR BILLS

The executive committee of the M. C. B. Association has issued circular No. 31 authorizing a 25 per cent increase to the face value of all car repair bills. The circular states: "Owing to the unusually large increase in the cost of labor and materials the executive committee is of the opinion that the addition of a certain percentage to car repair bills is justifiable, and therefore authorizes that, effective January 1, 1917, and continuing until October 1, 1917, unless otherwise modified, twenty-five (25) per cent shall be added to the face value of all car repair bills."

CARS AND LOCOMOTIVES ORDERED IN JANUARY

Orders for cars and locomotives were reported in January as follows:

	Locomotives	Freight cars	Passenger cars
Domestic	164	5,706	45
Foreign	168	3,400	..
Total	332	9,106	45

Among the important locomotive orders were the following:

Buffalo, Rochester & Pittsburgh	22	Mallet	American
	3	Pacific	American
	8	Switching	American
New York, New Haven & Hartford	50	Santa Fe	American
Northern Pacific	20	Santa Fe	American
	5	Mallet	American
Southern Pacific	24	Santa Fe	American
	9	Switching	Baldwin
Union Pacific	10	Mikado	Lima
British War Office	75	Prairie	Baldwin
	50	Consolidation	Baldwin
Chemin de Fer du Midi (France)	40	Consolidation	American

The freight car orders included among others the following:

Chicago, Burlington & Quincy	1,500	Gondola	Pressed Steel
Chicago, Milwaukee & St. Paul	1,000	Gondola	Tacoma shops
Illinois Central	500	Automobile	Standard Steel
Northern Pacific	500	Refrigerator	Pullman
	500	Gondola	Pressed Steel
Virginian	1,000	Hopper	Pressed Steel
French State Railways	3,000		
Java State Railway	400		Standard Steel

The 45 passenger cars included an order placed by the Boston Elevated for 35 subway cars with the Pressed Steel Car Company and an order for 10 express cars placed by the Delaware, Lackawanna & Western with the Pullman Company.

MEETINGS AND CONVENTIONS

Central Railway Club Dinner.—The annual dinner of the Central Railway Club will be held at Buffalo on March 8. Among the speakers of the evening will be Major-General Goethals, president of the Panama Railway Company and the Panama Railroad Steamship Lines. A committee, with J. L. Randolph, vice-president of the Economy Devices Corporation, as chairman, is arranging for a special train from New York City to Buffalo on the evening of March 7.

The June Mechanical Conventions.—The secretary of the Railway Supply Manufacturers' Association on January 13 sent out official circular No. 1 giving details concerning the annual exhibit of the association to be held at Atlantic City, June 13 to 20, in connection with the meetings of the Master Mechanics' and Master Car Builders' Associations. With the circular were enclosed applications for space. The assignment of space will be made February 23 at the office of the association in Pittsburgh. The circular notes that "From early indications there will be an unusual demand for space. Those who apply promptly will have the advantage of location."

General Foremen's Association.—The next annual convention of the International Railway General Foremen's Association will be held at the Hotel Sherman, Chicago, Ill., September 4, 5, 6 and 7, 1917. Committees have been appointed to report on the following subjects:

Engine Failures, Causes and Responsibilities. What Constitutes a Failure? W. R. Meeder, chairman, Chicago & Eastern Illinois, Danville, Ill.

Methods of Meeting the Requirements of Federal Inspection Laws. J. B. Wright, chairman, Hocking Valley, Columbus, Ohio.

Alignment of Locomotive Parts to Insure Maximum Service with Minimum Wear. B. F. Harris, chairman, Southern Pacific, Oakland, Cal.

What Interest Has the Locomotive Foreman with Car Department Matters? Charles Hobbs, chairman, Ann Arbor, Owosso, Mich.

The following list gives names of secretaries, dates of next or regular meetings and places of meeting of mechanical associations:

AIR BRAKE ASSOCIATION.—F. M. Nellis, Room 3014, 165 Broadway, New York City. Convention, May 1-4, 1917, Memphis, Tenn.

AMERICAN RAILROAD MASTER TINNERS', COPPERSMITHS' AND PIPEFITTERS' ASSOCIATION.—O. E. Schlink, 485 W. Fifth St., Peru, Ind.

AMERICAN RAILWAY MASTER MECHANICS' ASSOCIATION.—J. W. Taylor, Karpen Building, Chicago. Convention, June 13-15, 1917, Atlantic City, N. J.

AMERICAN RAILWAY TOOL FOREMEN'S ASSOCIATION.—R. D. Fletcher, Belt Railway, Chicago.

AMERICAN SOCIETY FOR TESTING MATERIALS.—Prof. E. Marburg, University of Pennsylvania, Philadelphia, Pa.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS.—Calvin W. Rice, 29 W. Thirty-ninth St., New York.

ASSOCIATION OF RAILWAY ELECTRICAL ENGINEERS.—Joseph A. Andreucetti, C. & N. W., Room 411, C. & N. W. Station, Chicago.

CAR FOREMEN'S ASSOCIATION OF CHICAGO.—Aaron Kline, 841 Lawlor Ave., Chicago. Second Monday in month, except June, July and August, Hotel La Salle, Chicago.

CHIEF INTERCHANGE CAR INSPECTORS' AND CAR FOREMEN'S ASSOCIATION.—W. R. McMunn, New York Central, Albany, N. Y.

INTERNATIONAL RAILROAD MASTER BLACKSMITHS' ASSOCIATION.—A. L. Woodworth, C., H. & D., Lima, Ohio.

INTERNATIONAL RAILWAY FUEL ASSOCIATION.—J. G. Crawford, 547 W. Jackson Blvd., Chicago. Convention, May, 1917, Chicago.

INTERNATIONAL RAILWAY GENERAL FOREMEN'S ASSOCIATION.—William Hall, 1126 W. Broadway, Winona, Minn. Convention, September 4-7, Hotel Sherman, Chicago, Ill.

MASTER BOILERMAKERS' ASSOCIATION.—Harry D. Vought, 95 Liberty St., New York. Convention, May 22-25, 1917, Richmond, Va.

MASTER CAR BUILDERS' ASSOCIATION.—J. W. Taylor, Karpen Building, Chicago. Convention, June 18-20, 1917, Atlantic City, N. J.

MASTER CAR AND LOCOMOTIVE PAINTERS' ASSOCIATION OF U. S. AND CANADA.—A. P. Dane, B. & M., Reading, Mass.

NIAGARA FRONTIER CAR MEN'S ASSOCIATION.—E. N. Frankenberger, 623 Brisbane Building, Buffalo, N. Y. Meetings, third Wednesday in month, New York Telephone Bldg., Buffalo, N. Y.

RAILWAY STOREKEEPERS' ASSOCIATION.—J. P. Murphy, Box C, Collinwood, Ohio.

TRAVELING ENGINEERS' ASSOCIATION.—W. O. Thompson, N. Y. C. R. R., Cleveland, Ohio.

RAILROAD CLUB MEETINGS

Club	Next Meeting	Title of Paper	Author	Secretary	Address
Canadian	Feb. 13, 1917	The Chilled Iron Car Wheel: Its Past, Present and Future	Geo. W. Lyndon	James Powell	P. O. Box 7, St. Lambert, Que.
Central	Mar. 8, 1917	Annual Dinner; Address by Major-General G. W. Goethals		Harry D. Vought	95 Liberty St., New York.
Cincinnati	Feb. 13, 1917	Demonstration of the Automatic Stop	Julian Beggs	H. Boutet	101 Carew Bldg., Cincinnati, Ohio.
New England	Feb. 13, 1917	Electrical Night		Wm. Cade, Jr.	683 Atlantic Ave., Boston, Mass.
New York	Feb. 16, 1917	Cost Accounting	Henry Lehn	Harry D. Vought	95 Liberty St., New York.
Pittsburgh	Feb. 23, 1917			J. B. Anderson	207 Penn Station, Pittsburgh, Pa.
Richmond	Feb. 12, 1917	Valuation	James P. Nelson	F. O. Robinson	C. & O. Railway, Richmond, Va.
St. Louis	Feb. 9, 1917	Locomotive Inspection Laws and Rules, Their Purposes and Accomplishments	Frank McManamy	B. W. Frauenthal	Union Station, St. Louis, Mo.
South'n & S'w'rn.	Mar. 15, 1917			A. J. Merrill	Box 1205, Atlanta, Ga.
Western	Feb. 19, 1917			Jos. W. Taylor	1112 Karpen Bldg., Chicago.

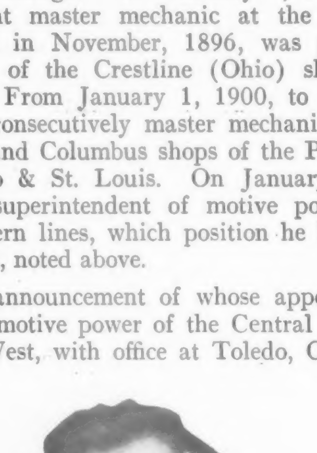
Personal Mention

GENERAL

PERSIFER FRAZER SMITH, JR., whose appointment as general superintendent of motive power of the Pennsylvania Lines West, with headquarters at Pittsburgh, Pa., was announced in these columns last month, was born August 1, 1870, at West Chestnut, Pa. After leaving high school he entered Warralls Technical Academy, from which he graduated in June, 1887. In October, 1887, he was employed by the Pennsylvania as an apprentice in the shops at Altoona, Pa. After several minor promotions he was appointed assistant road foreman of engines on the Pittsburgh division in February, 1892, and in August, 1893, was transferred with same title to the western division of the Pittsburgh, Ft. Wayne & Chicago. On February 1, 1895, he was appointed assistant master mechanic at the Ft. Wayne (Ind.) shops, and in November, 1896, was promoted to master mechanic of the Crestline (Ohio) shops and the Toledo division. From January 1, 1900, to December 31, 1911, he was consecutively master mechanic of the Logansport, Dennison and Columbus shops of the Pittsburgh, Cincinnati, Chicago & St. Louis. On January 1, 1912, he was appointed superintendent of motive power, of the central system, western lines, which position he held until his recent appointment, noted above.

P. F. Smith, Jr.

OLIVER P. REESE, the announcement of whose appointment as superintendent of motive power of the Central system, Pennsylvania Lines West, with office at Toledo, Ohio, was made in these colums last month, was born on May 29, 1876, at Louisville, Ky. He graduated from Purdue university in 1898, and the following August entered railway service as an apprentice with the Louisville & Nashville, at Louisville, Ky. From January, 1900, to September of the same year he was a draftsman in the Pennsylvania shops at Allegheny, Pa., and from September, 1900, to September, 1901, he was engaged on special work for this same company at its shops at Ft. Wayne, Ind. In September, 1901, he was made a special apprentice, and in August, 1903, appointed gang foreman in the shops at Allegheny, Pa. From February, 1904, to December the same year he was foreman of tests for the company at the St. Louis world's fair, following which he was appointed motive power inspector. From May, 1904, to May, 1906, he was general division foreman, and in June, 1908, was promoted to division master mechanic. In June, 1910, he became assistant engineer of motive power, and in September, 1911, was advanced to master mechanic. On May 31, 1915, he was appointed assistant engineer of motive power in the office of the general superintendent of motive power, which position he held at the time his appointment as superintendent of motive power became effective, as noted above.



O. P. Reese

W. H. DOOLEY, formerly superintendent of motive power of the Alabama Great Southern, the Cincinnati, New Orleans & Texas Pacific, and the Harriman & North Eastern, has been appointed superintendent of motive power of the Southern Railway, Lines West, with headquarters at Cincinnati, Ohio.

W. S. MURRIAN, superintendent of motive power of the Southern Railway, with headquarters at Knoxville, Tenn., will take the position of superintendent of motive power, both for the Lines East and West, with headquarters as heretofore, at Knoxville, Tenn.

GROVER C. NICHOLS, whose appointment as superintendent of motive power and equipment of the Alabama, Tennessee & Northern, with headquarters at York, Ala., has already been announced in these columns, was born on September 19, 1885, at Jonesboro, Ark., and was educated in the public high schools. He began railway work on June 9, 1902, as call boy on the St. Louis Southwestern. The following year he became machinist apprentice, and from June, 1907, to March, 1911, he was machinist. He was then appointed master mechanic of the Jonesboro, Lake City & Eastern, at Jonesboro, Ark., remaining in that position until October, 1912; the following month he returned to the service of the St. Louis Southwestern as roundhouse foreman. On September 1, 1913, he was appointed master mechanic of the Alabama, Tennessee & Northern, which position he held until his recent promotion as superintendent of motive power and equipment on the same road.

E. C. SASSER, superintendent of motive power of the Southern Railway, with headquarters at Washington, D. C., has been appointed superintendent of motive power of the Lines East, with headquarters at Charlotte, N. C.

ORRVILLE C. WRIGHT, assistant engineer of motive power, Northwest system, of the Pennsylvania Lines West, at Ft. Wayne, Ind., has been appointed assistant engineer of motive power of the Lines West, with office at Pittsburgh, Pa.

MASTER MECHANICS AND ROAD FOREMEN OF ENGINES

C. GRIBBINS has been appointed division master mechanic of the Smiths Falls division of the Canadian Pacific with office at Smiths Falls, Ont., succeeding F. Ronaldson, promoted.

W. B. JOHNSON has been appointed master mechanic of district 6, Intercolonial division of the Canadian Government Railways, with headquarters at Truro, N. S.

LLOYD B. JONES, formerly assistant engineer of motive power of the Pennsylvania Railroad at Williamsport, Pa., has been appointed master mechanic with headquarters at Verona, Pa. Mr. Jones was born on September 30, 1892, at West Grove, Pa. He graduated from Cornell University in 1904 and began railroad work on July 22, 1904, with the Pennsylvania Lines West as a special apprentice. He became a locomotive fireman on November 9, 1906, and was appointed enginehouse foreman at Logansport, Ind., on February 1, 1907. On July 1, 1908, he entered the

office of the superintendent of motive power at Columbus, Ohio, as assistant electrician and on March 1, 1910, was made electrician of the Vandalia Railroad. From February 28, 1911, to February 1, 1912, he was inspector at the Columbus shops and then did special work in the office of the superintendent of motive power until December 1, 1912, when he again became an inspector in the Columbus shops. On January 1, 1913, he was appointed assistant engineer of motive power of the Central system, later being transferred to the Southwestern system. On May, 1, 1916, he was transferred to the Pennsylvania Railroad, becoming assistant engineer of motive power at Williamsport, Pa., holding that position at the time of his recent promotion to the position of master mechanic.

George J. Richers, formerly enginehouse foreman of the Pennsylvania Railroad at West Brownsville Junction, has been appointed assistant master mechanic with office at Verona, Pa. Mr. Richers was born on June 10, 1893, and was educated at the University of Pennsylvania. He entered railroad service on August 3, 1900, as a messenger in the office of the chief motive power clerk, becoming a regular apprentice on September 16, 1901, and was subsequently promoted to several minor positions in the Altoona machine and car shops. On December 27, 1910, he was appointed a member of the Efficiency Committee of the Philadelphia Terminal division, and on October 9, 1912, was made inspector in the office of the master mechanic of the Pittsburgh division. He became enginehouse foreman at West Brownsville Junction on August 16, 1915, holding that position until his recent appointment as assistant master mechanic.

SHOP AND ENGINEHOUSE

J. L. Jamieson has been appointed foreman of locomotives of the Medicine Hat division, Alberta district of the Canadian Pacific at Medicine Hat, succeeding W. J. McLean, transferred.

Arthur T. Kuehner, formerly district motive power inspector of the Baltimore & Ohio, has been appointed general foreman at Riverside, Md.

PURCHASING AND STOREKEEPING

E. G. Goodwin has been appointed fuel agent of the Southern Railway Lines East, with headquarters at Knoxville, Tenn.

Eugene McAuliffe, general fuel agent of the St. Louis-San Francisco, with office at St. Louis, Mo., has resigned, effective February 1, to become vice-president of the West Kentucky Coal Company of Paducah, and Sturgis, Ky. He was born in 1866, at London, Eng., coming to this country as a young boy. In 1884 he entered railway service with the Northern Pacific as a shop apprentice. Later he was advanced to locomotive fireman and then to engineer with this same company. Subsequently he spent five years in the mechanical and operating departments of various railroads in the United States and Mexico, and in 1894 entered the service of the Kansas City, Ft. Scott & Memphis, now a part of the Frisco system, being appointed fuel agent in 1903. In 1908 he was appointed general fuel agent of the Chicago, Rock Island & Pacific, the St. Louis-San Francisco and the Chicago & Eastern Illinois jointly, at about the same time becoming president of the Brazil Block Coal Company, and in 1910 general manager of the Crawford Valley Mining Company. He organized the Railway Fuel Association, of which he was president in 1908 and 1909.

H. Shoemaker, formerly district storekeeper of the Baltimore & Ohio, at Wheeling, W. Va., has been appointed district storekeeper of the Southwest district and the Cincinnati, Hamilton & Dayton with headquarters at Cincinnati, Ohio, succeeding H. P. McQuilkin, promoted.

Supply Trade Notes

Frederick S. Bennett, for many years associated with the Railroad Gazette and the Railway Review, died in Chicago, Ill., January 19.

John O. Pew, for four years president and general manager of the Youngstown Iron & Steel Company, Youngstown, Ohio, has resigned.

C. L. Mellor, formerly western representative of the Barco Brass & Joint Company, Chicago, has been appointed manager of sales, with headquarters in Chicago.

L. W. Miller, formerly eastern representative of the Barco Brass & Joint Company, Chicago, has resigned to accept a position with Fahn-McJunkin, Inc., New York City.

Charles Cyrus Ramsey, president of the Crucible Steel Company of America, died January 11, at Pittsburgh, following an attack of pneumonia, contracted five weeks ago.


C. C. Ramsey

Mr. Ramsey was born in Allegheny City, February 25, 1862. He started his business career as stenographer in the office of the assistant general freight agent of the Pennsylvania Company. When 23 years of age, he left the employ of the railroad and became a stenographer in the office of Park Brothers & Co., Ltd., then the largest manufacturers of crucible steels in this country. Gradually he rose from one position to another until he became manager of their Philadelphia branch, and then manager of the New York branch in charge of the entire eastern district. He held this position until the organization of the Crucible Steel Company was completed in 1900, when Park Brothers & Co., Ltd., or rather their successor, the Park Steel Company, was absorbed into the present Crucible Steel Company of America. Serving for a time with R. E. Jennings in the management of the eastern business of the company, he was shortly made, on Mr. Jennings' retirement, fourth vice-president and permanent manager of the eastern office. In the winter of 1910 the death of Frank B. Smith, then president of the Crucible Steel Company, caused a vacancy. Mr. Ramsey was called to Pittsburgh as assistant to the president, which latter office was then temporarily held by Mr. DuPuy. The board soon recognized Mr. Ramsey's ability and in July, 1910, he was unanimously elected president of the Crucible Steel Company, and, soon thereafter, of its affiliated companies; these positions he held until his death.

W. W. Darrow, secretary of the Camel Company, manufacturers of railway specialties and supplies, with general offices at Chicago, has been appointed general manager of this company, effective January 1.

The sale of the properties of the Wharton Steel Company to J. Leonard Replogle, vice-president of the American Vanadium Company, was completed January 13. The properties include two large blast furnaces and a smaller one, the Wharton Northern Railroad, the Hibernia mine

near Wharton, N. J., and smaller mines in the same group, including the Allen-Teabo, Orchard, Scrub Oaks and Mount Pleasant—in all about 5,000 acres of iron ore lands.

At a meeting of the board of directors of the Crucible Steel Company of America, held in Pittsburgh January 16, Herbert DuPuy, chairman of the board, was also elected temporary president. He will continue to hold the office of chairman.

H. T. Armstrong, for the past three years connected with the sales department of the American Locomotive Company at Montreal, Can., has been assigned to the sales department of this company's Chicago office, calling on all railroads and industrial concerns using locomotives in western territory.

The circuit court of appeals for the second district has handed down a decision in the case of Safety Car Heating & Lighting Company v. Gould Coupler Company, in which it holds that the Gould "Simplex" system of electric car lighting is not an infringement of the H. G. Thompson patent No. 1,070,080, owned by the Safety Car Heating & Lighting Company.

H. D. Savage, vice president of the American Arch Company, in addition to his present duties, has been appointed manager of sales of the industrial department of the Locomotive Pulverized Fuel Company, with office at 30 Church street, New York. Mr. Savage was born in 1880 at Memphis, Tenn. He was educated in the public schools at Ashland, Ky., and at the Kenyon Military Academy. In 1897 he entered the manufacturing department of the Ashland Fire Brick Company and served in various capacities up to 1904, at which time he was appointed manager of sales. In 1914 he was elected vice president of the American Arch Company, which position he will still hold in addition to his new appointment, above noted.

H. D. Savage

At a meeting of the board of directors of the American Locomotive Company, held January 17, the following officers were elected, effective February 1: Columbus K. Lassiter, vice-president in charge of manufacture; Harry B. Hunt, assistant vice-president in charge of manufacture; James D. Sawyer, vice-president in charge of sales; Joseph Davis, vice-president and comptroller.

Waldo H. Marshall, whose resignation as president of the American Locomotive Company was accepted a few weeks ago, after a long fight had been waged against the management by Isaac Cate, of Baltimore, and other minority stockholders, has become associated with J. P. Morgan & Co. In his new position he will assist E. R. Stettinius, the partner in charge of the export department.

Ellis J. Hannum, secretary of the Newton Machine Tool Works, Inc., Philadelphia, died January 7. Mr. Hannum had been in the service for 29 years. He entered the employ of the company as a boy and was most closely associated with the drafting and engineering departments. During the past two years, failing health caused him to give up active engineering work and during this time he acted in an advisory capacity to the advertising department.

W. L. Batt has been made sales manager of the Hess-Bright Manufacturing Company, Philadelphia, and will have entire charge of its sales after February 1, 1917. Mr. Batt has been connected with the Hess-Bright manufacturing organization since its early days, and has for many years been engaged in doing much of the pioneer work that was necessary to develop the industry in this country.

Stowell Cortland Stebbins, western sales and advertising manager of the Lansing Company, Lansing, Mich., the announcement of whose election as secretary was made in these columns last month, was born at Lansing, Mich., July 29, 1886. After leaving high school he attended the Michigan Agricultural College, and the University of Michigan at Ann Arbor, Mich. In July, 1910, he entered the employ of the Lansing Company as an assistant timekeeper, and a year later was transferred to the sales department. In 1912 he was appointed western sales manager, and in 1914 he also took over the duties of advertising manager, holding these two positions until his present election, as noted above. In addition he was also elected a member of the board of directors. He succeeds Harry E. Moore, elected vice-president.

S. C. Stebbins

Walter J. McBride, formerly president of the Haskell & Barker Car Company, Michigan City, Ind., died at his home in Chicago, January 18, at the age of 56. He was born on May 2, 1861, and entered commercial life at the age of 16, as an office boy with the Peninsula Car Company, Detroit, Mich. He was with that company for nearly 15 years and at the time of its consolidation with the Michigan Car Company, Detroit, was elected secretary of the new corporation. In 1899, when the American Car & Foundry Company was organized, he was elected auditor and shortly thereafter promoted to assistant to the president and later to vice-president and general manager. In 1907, he resigned as vice-president of the American Car & Foundry Company to become associated with the late John H. Barker, president of the Haskell & Barker Car Company as vice-president. At the death of John H. Barker, he became president of the company and continued in that position until the sale of the corporation to the present owners in 1916.

W. J. McBride

Effective January 1, 1917, the business heretofore conducted under the name of the Railway Supply & Equipment Company, of Atlanta, Ga., will be continued under the name

of the Bradford Draft Gear Company, the Bradford Draft Gear Company having purchased and taken over the business of the Railway Supply & Equipment Company. All contracts and agreements with the Railway Supply & Equipment Company will be taken care of by the Bradford Draft Gear Company. The management of the new company will be the same as the old.

J. G. Blunt, superintendent of the general drawing room of the American Locomotive Company has been appointed mechanical engineer of that company with headquarters at Schenectady, N. Y. Mr. Blunt has been in the employ of the company or its predecessors since 1897. He was born April 7, 1868, at Cincinnatus, N. Y. He took the mechanical engineering course at the University of Michigan. After spending four years as machinist and draftsman with various manufacturing companies, he accepted a position in 1897 as a draftsman with the Brooks Locomotive Works at Dunkirk, N. Y., and later became chief draftsman of that company. Mr. Blunt has been in the service of the American Locomotive Company or its predecessors continuously since that time. When the engineering work of all the company's plants was consolidated at Schenectady he was transferred to that plant as engineer of the drafting department and later became superintendent of the general drawing room.


J. G. Blunt

Arthur L. Humphrey, first vice-president and general manager of the Westinghouse Air Brake Company, has been elected president of the Union Switch & Signal Company in accordance with merger proceedings of the two companies, and will hereafter assume the executive responsibility of both offices. Mr. Humphrey was born in Erie county, New York, but his family moved to Iowa when he was less than a year old. At the age of 14, after the usual amount of country schooling, he struck out for himself, passing successively through the positions of store-hand, cow-boy, substitute cook, machinist apprentice, gang boss, mining engineer and general contractor—all in the new pioneer territory lying between the Missouri river and the Pacific coast. At the age of 22 he organized a general machine shop and foundry in Seattle, which afterwards developed into the present extensive Moran Iron Works. He then went into railroading and became constructing division foreman of the Mojave division of the Central Pacific, then master mechanic and later superintendent of motive power of the Colorado Midland. In 1893, political urgency, due to Populistic activity, caused the business men of Colorado to combine and combat that influence in the Colorado legislature by electing a business man to the state legislature. Mr. Humphrey was chosen and elected, serving two terms, one as speaker of the house. He went back to railway service, however, on the Colorado Southern and in 1899 then went to the Chicago & Alton in 1903 as superintendent of motive power. He became western manager of the Westinghouse Air Brake Company in 1893, general manager in 1905, and vice-president and general manager in 1910. Air brake and block signal development in the control of railroad train movement has become so inter-related from an engineering standpoint that closer co-operation between these two Westinghouse interests has been inevitable for some years and indeed was originally planned by the late George Westinghouse himself. Mr. Humphrey's broad experience as a railroad man qualifies him effectively for the new responsibilities assumed.


A. L. Humphrey

Hugh M. Wilson, formerly associated with The Railway Age and for several years its owner, and since 1910 first vice-president of the McGraw Publishing Company, has resigned from the latter position to devote himself to his personal interests. Mr. Wilson has been in journalistic work during practically his entire business life. His first experience was as city editor of the Jacksonville (Ill.) Daily Journal. He subsequently was reporter on the Minneapolis Evening Star, but in 1889 changed to the technical paper field and joined the staff of the Mississippi Valley Lumberman. With but one brief interruption since he has devoted his energy and abilities to the object of developing magazines in trade and technical lines. He gained his first experience with railroad papers, as an associate editor of the Northwestern Railroader and shortly after that publication was consolidated with The Railway Age, at Chicago, he was made secretary-treasurer of the new organization. He subsequently became manager of The Railway Age, meanwhile continuing as secretary-treasurer, and was elected president of the company in 1899. In these years, although busily engaged in the business department of the paper, he found much time for editorial work, particularly on news matters relating to the purchase of equipment and supplies. His familiarity with this branch of railroad work soon made him an authority and fitted him for the work he did as secretary of the Railway Supply Manufacturers' Association from 1897 to 1902. His energy was perhaps best displayed by the publication during the International Railway Congress at Washington, in 1905, of a daily edition of The Railway Age, which was designated as the official journal of the congress. Supplementing the praise showered on him by both American and foreign delegates for the success of this enterprise, he was created a chevalier of the Order of Leopold by the King of the Belgians. In 1906 the Wilson Company, with Mr. Wilson as the controlling owner, was organized, taking over The Railway Age and the Street Railway Review, which had just then been purchased and which was changed shortly to the Electric Railway Review and from a monthly to a weekly publication. Two years later Mr. Wil-


H. M. Wilson

son sold both papers. The Railway Age was consolidated with the Railroad Gazette to make the present Railway Age Gazette, while the McGraw Publishing Company purchased the Electric Railway Review and consolidated it with the Street Railway Journal under the name of the Electric Railway Journal. Mr. Wilson immediately went abroad for an extended trip, and on his return in June, 1909, was elected vice-president and a director of the Barney & Smith Car Company, Dayton, Ohio. He continued with the Barney & Smith Car Company until 1910 when he was elected first vice-president of the McGraw Publishing Company, the position he is now relinquishing.

Henry Lindenkohl was, on December 1, appointed engineer of construction of the American Locomotive Company, with headquarters at Schenectady, N. Y. Mr. Lindenkohl was born at Roselle, N. J., on December 26, 1883. He attended the public schools at Elizabeth, N. J., and later entered Stevens Institute of Technology, from which he graduated with the degree of mechanical engineer in 1905. The same year he entered the employ of the American Locomotive Company at Providence, R. I., as inspector of new buildings. In 1908 he was transferred to the general building construction department of the company at Schenectady, N. Y.

The Chicago Car Heating Company, Chicago, announces that, by a recent decision of the commissioner of patents in the interference suit between the Chicago Car Heating Company and the Consolidated Car Heating Company, dating from 1908 over certain vapor heating system patent claims, the contentions of the Chicago Car Heating Company were sustained in all respects. The decision has now become final from which no appeal has been or can be taken, and the Cosper Application (owned by the Consolidated Car Heating Company) has been abandoned, and no patent will be granted to the Consolidated Car Heating Company relating to any matter involved in that interference.

There still remains in litigation the Chicago Car Heating Company's suit against the Gold Car Heating & Lighting Company in the U. S. District Court of New York, for infringement of vapor heating system patents; and also suit of the Chicago Car Heating Company against the Standard Heat & Ventilation Company, in the U. S. District Court of Chicago, for infringement of vapor heating system patents.

The Interstate Iron & Steel Company, Chicago, recently has bought outright the entire property and business of the Grand Crossing Tack Company, Chicago. This purchase gives the Interstate Iron & Steel Company, in addition to its present works, an open hearth steel plant and a blooming mill, as well as a complete line of nails, wire and wire products. Samuel Hale, formerly with the Wisconsin Steel Company, Chicago, and later general manager of the Algoma Steel Corporation, Sault Ste. Marie, Ont., becomes vice-president in charge of the steel division. There will be no other change in the management, S. J. Llewellyn remaining as president and George F. Davie as vice-president and treasurer. The Interstate Iron & Steel Company started in 1905 in a small way with a rolling mill at East Chicago for the manufacture of iron and steel bars and shapes. At that time it had a capacity of about 30,000 tons per year. It has always been active in the railway supply field. With the properties it has recently acquired, and with improvements which will soon be finished, it will have plants having an output of 275,000 tons annually. Its products now include common bar iron, plain and twisted reinforcing bars, refined bar iron, bar iron for car work, engine bolt and stay bolt iron, wrought iron and steel tie plates, and a full line of steel bars, wire rods, wire nails and other wire products. It now has iron rolling mills at East Chicago, Ind.; high carbon steel rolling mills at Marion, Ohio; an open hearth plant and a blooming mill at South Chicago, and a rod mill and wire works at Seventy-ninth street, Chicago.

CATALOGUES

SAWS.—The Simonds Manufacturing Company, Fitchburg, Mass, has issued a 180-page catalogue of its line of saws, knives, files and special steels.

POWER HAMMERS.—The United Hammer Company, Boston, Mass., has issued a small 16-page booklet describing and illustrating its line of Fairbanks power hammers.

PORTABLE TOOLS.—Portable Tools of Chosen Value is the title of a small booklet recently issued by the Stow Manufacturing Company, Binghamton, N. Y., manufacturers of Stow flexible shafting.

MACHINE TOOLS.—The Gisholt Machine Company, Madison, Wis., has recently issued a 16-page booklet containing reprints of a number of full page advertisements that appeared in the American Machinist.

HOSE—ELECTRIC HOISTS.—Bulletins Nos. 129 and E-45, recently issued by the Chicago Pneumatic Tool Company, Chicago, deal respectively with hose, hose couplings and hose clamp tools, and with Duntly portable electric hoists.

LOCOMOTIVE DEVICES.—The Franklin Railway Supply Company, New York, in series E bulletin 600, illustrates and describes the Franklin automatic adjustable driving box wedge, and in series C bulletin 401, McLaughlin flexible conduits.

TRANSIT REFRIGERATION.—A bulletin recently issued by the Refrigerator Car Equipment Company, Chicago, entitled "Waste in Transit Refrigeration Transformed into Efficiency and Profits" describes the company's A B C system of transit refrigeration.

FABROIL GEARS, formerly known as the cloth pinons, form the subject of a profusely illustrated descriptive bulletin No. 48702, of the General Electric Company. Commercial data on "Fabroil" gears and useful information for gear calculations are given in bulletin No. 48703.

WASHING AND COOLING AIR.—A rather attractive booklet, bulletin No. 150, recently issued by the Spray Engineering Company, Boston, Mass., deals with Spraco equipment for washing and cooling air for steam turbine generators. The booklet describes the company's water-spray type of air-washer and cooler, taking up the details of its construction and operation. A number of views of the air-washers are shown in operation and in course of construction.

BALL BEARING HANGERS.—The latest catalogue issued by the S. K. F. Ball Bearing Company, Hartford, Conn., bears the title S. K. F. Self-aligning Ball Bearing Hangers and Pillow Blocks. The booklet contains 48 well illustrated pages and takes up in detail such subjects as Power Saving, the Use of Smaller Motors, Saving in Lubrication and Inspection, Reduced Fire Hazard, etc. Several pages are devoted to tables and curves and engineering data on mounting, lubrication, testing lubricants, felt seats, etc. Announcement is also made of the S. K. F. engineering service.

RAILWAY SPEED RECORDER.—Bulletin No. 263, recently issued by the Chicago Pneumatic Tool Company, illustrates and describes the Boyer railway speed recorder. The bulletin also gives instructions for applying and operating the recorder, and explains that by examining the chart which it makes, the exact speed at which the train passed any point on the road, the number and location of stops, the distance, speed and location of any backward movement that may have been made, can be determined at a glance. Several pages are devoted to the new Boyer speed recorder with clock attachment.